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# A NEW NASAL MITE (RHINONYSSIDAE) FROM THE HORNED LARK, AND TAXONOMIC MISCELLANEA ON SEVERAL OTHER SPECIES

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*Paraneonyssus capitatus* n. sp.
(Figs. 1-3)

Through the courtesy of Mr. H. B. Morlan, I received eight heads of the horned lark, *Otocoris alpestris,* collected by him near Tooele, Utah. Three of these heads contained nasal mites herein described as a new species.

The horned lark is the only representative in the United States of the Passerine family Alaudidae. Since it is a distinctive family of Passeriformes it would be expected to have a species of mites conforming generically to those of the other passeriforme birds but specifically unique, and such is indeed the case. These mites conform nicely to the generic concept of *Paraneonyssus* but are strikingly different in the capitate setae, tarsal spurs and angulate attachment of the ambulacra.

FEMALE. With a small but distinct tritosternum, several large, terminally expanded setae on both dorsum and venter, and the ambulacra of legs II, III, and IV attached at a 45° angle to the long axis of the segment. Average length, 480 microns, varying from 450 to 500; average width at widest point, 270 microns.

*Dorsum* (Fig. 2): The anterior dorsal plate is large, rounded, wider than long, and with a bi-concave posterior margin. It averages 173 microns long on the mid-line and 187 microns wide at the widest point. It bears 3 pairs of very small setae, two pairs of large capitate setae, and one pair of capitate setae of intermediate length. The opisthosomal plate is quadrangular and measures 153 microns long by 120 microns wide. It bears one pair of tiny terminal setae and one pair of long capitate setae marginally on the posterior one third. The non-sclerotized portion of the opithosoma bears four pairs of setae, the most anterior is very tiny, the posterior ones large and capitate. The stigma, with short peritreme, is dorsal, just back of the center of coxa III.

*Venter* (Fig. 1): A very small but distinct tritosternum with two lacinae is present (Fig. 3c). The sternal plate is lightly stippled but the margins are not always distinct. It has two pairs of pores and three pairs of setae which are slightly capitate and of increasing length posteriorly. The setae are not always on the plate. The metasternal seta and pore are lacking. Average length of sternal plate, 100 microns.

*Epigynial plate:* Extends slightly beyond coxae IV, fairly broad, and bears a pair of minute setules.

*Anal plate:* Broadly oval, fully as wide as the epigynial, anal pore in the anterior third, and with three equal, capitate setae. The paired setae are

anterior of the front margin of the pore. Generally the setae and pore are ventral and the cribrum is terminal but often the pore is terminal and the cribrum, therefore, dorsal. The non-sclerotized portion of the venter bears only two pairs of setae, both between the anal and epigynial plates. The more anterior pair is large and capitate; the more posterior is small but also capitate.

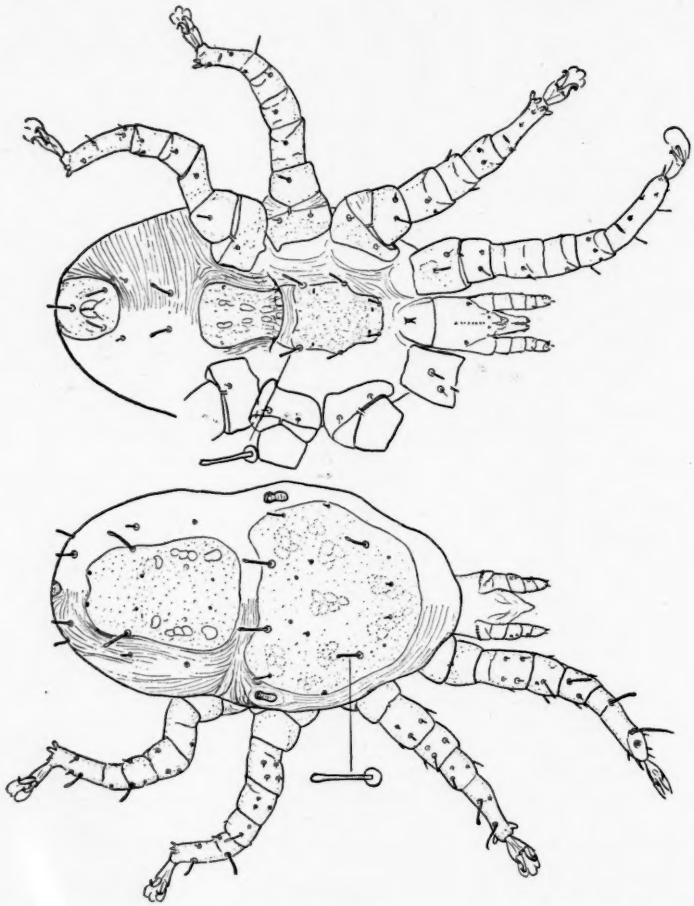

PLATE I

*Paraneonyssus capitatus* n. sp., female. Fig. 1, above, ventral view; Fig. 2, below, dorsal view.

*Legs:* The inner seta of coxa I is large and capitate; all other coxal setae are small with little if any apical swelling. All trochanters have a capitate seta ventrally. All other ventral leg setae are small and slender, except at the apices of tarsi II-IV where there are four thick, blunt, spur-like setae (Fig. 3e). Dorsally, genuae I and II, and tibiae I-IV have each a capitate

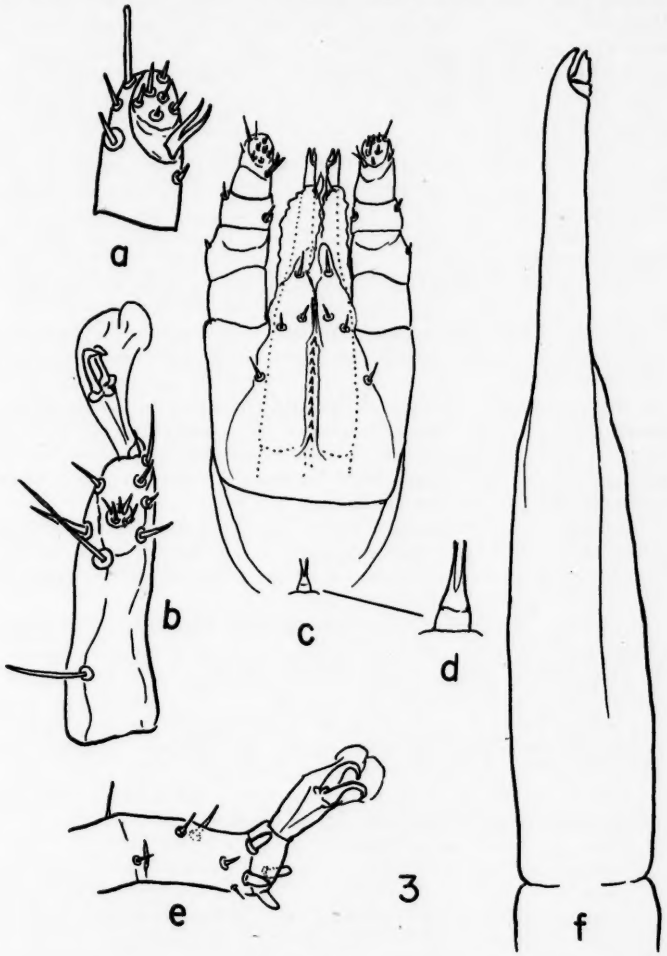


PLATE II

*Paraneonyssus capitatus* n. sp., female. Fig. 3a, ventral view of left pedipalpal tibia and tarsus; Fig. 3b, dorsolateral view of tarsus I; Fig. 3c, gnathosoma and tritosternum, ventral view; Fig. 3d, tritosternum, enlarged; Fig. 3e, lateral view of tarsus II; Fig. 3f, chelicera, enlarged.

seta; tarsi I-III have each one capitate seta and one long slender seta; tarsus IV has one capitate seta. Ambulacral claws of tarsus I (Fig. 3b) functionally developed.

*Gnathosoma* (Fig. 3): Movable segment of pedipalps slightly longer than fused coxae. Gnathosomal and hypostomal setae all present, slender and acuminate. Specialized forked palpal seta present, with both tines well developed. Number of deutosternal teeth varies from seven to eleven; the most usual number is eight. Chelicera not bulbous but the basal two-thirds about twice as thick as the apical one-third. Chela minute. Tectum (Fig. 2) either smooth-margined or with minute dentules; membranous, long. The anterior dorsal margin of the pedipalpal coxa bearing small denticles.

*Male* and *immature* stages unknown.

*Types:* Described from the holotype female and eleven paratype females. Holotype and several paratypes deposited in the U.S. National Museum, Washington, D.C.

*Type host: Otocoris alpestris* (Linn.), the horned lark. *Habitat:* The nasal turbinates.

*Type locality:* Tooele, Utah. August 13, 1951. Harvey B. Morlan, collector.

*Remarks:* May be distinguished from all other species of the genus by its apically expanded setae and by the four spur-like setae on the apices of tarsi II-IV.

The mite is apparently not common. In addition to the eight heads mentioned above, we have examined fourteen more heads collected at Tooele, Utah, on a later date; two heads collected September 13, at Lubbock, Texas, and two heads collected March 24, at Rockport, Texas. Of a total of twenty-six birds, only three had mites (7, 3, 2).

Of some interest is the small but distinct tritosternum. This occurs also in a few other species of *Rhinonyssidae* but is by no means common. Whether its presence justifies the erection of a new genus is debatable but we are of the opinion that it does not.

I have had the opportunity recently through the kindness and courtesy of Dr. G. W. Wharton and Dr. E. W. Baker, to study the type material in the U.S. National Museum, Washington, D.C. Several cases of synonymy and incorrect combinations were discovered.

Correspondence in April, 1952, with Dr. Margaret Hughes, University of London, established the synonymy of two species of laelaptid mites, which she graciously asked me to place on record.

Recently an internal mite of a heron was described which seems quite certainly to be identical with one described several years earlier.

These corrections and a few others are given below.

## RHINONYSSIDAE

*Ptilonyssus orientalis* (Ewing), New combination

*Sommatericola orientalis* Ewing, 1933, Proc. U.S. Natl. Mus. 82(30):13.

The specimen is somewhat folded and the posterior portion not well cleared, making it difficult to see the plates and some of the setae. It is pos-

sible to see, however, the bulbous chelicerae and the small pygidial plate characteristic of *Ptilonyssus sensu strictu*. The host was a shrike, *Lanius nigriceps longicaudatus*, from Bangkok, Siam. The type specimen is in the U.S. National Museum, Washington, D.C.

*Neonyssus belepolskii* Bregetova, 1950, Reports of the Academy of Science USSR. No. 5.

*Neonyssus ardeae* Zumpt and Till, 1955, Jour. Ent. Soc. S. Afr. 18:63. New synonymy.

The nominal host was the heron, *Ardea cinerea*. Zumpt and Till's specimens were from *Ardea melanocephala*. The excellent descriptions and illustrations of both Bregetova and Zumpt and Till leave no doubt about the above synonymy. I have also taken the species in Texas, U.S.A., from the tricolored heron, *Hydranassa tricolor*.

## DERMANYSSIDAE

*Ornithonyssus bacoti* (Hirst), 1913. (=*Bdellonyssus*, =*Liponyssus*)

*Haemogamasus sanguineus* Ewing and Stover, 1915, Ent. News 26:109. New synonymy.
*Liponyssus tenuiscutatus* Ewing, 1922, Proc. U.S. Natl. Mus. 62(13):22. New synonymy.

The type slide of *H. sanguineus* has the name *Haemogamasus* struck out and *Liponyssus* written under it. This in turn is struck out, and also *sanguineus*, and both names replaced by "*L. bacoti*," all in Ewing's hand. He, therefore, recognized the specimen as *bacoti* but if this has ever been published it has escaped my notice. The specimen is very much flattened and although lightly stained it is very transparent. It is deposited in the U.S. National Museum, Washington, D.C.

The specimen of *L. tenuiscutatus* is compressed laterally, making the dorsal plate seem longer than it actually is. Otherwise there is no structural difference separating this from *O. bacoti*. Taken at Pascagoula, Mississippi, on sweet potatoes from Cuba. Type is in the U.S. National Museum, Washington, D.C.

*Ichoronyssus crosbyi* (Ewing). New combination

*Liponyssus crosbyi* Ewing, 1915, Ent. News 26:112.

The type slide has the name *Liponyssus* struck out and replaced by *Leiognathus*. This is also struck out and replaced by *Tetragonyssus*. It is, in fact, an *Ichoronyssus* in the sense of Fonseca and very closely related to *Ichoronyssus longisetosus* Furman. The specimen was taken from a bat, *Vesper subulatus*, at Rockport, Missouri. The type is in the U.S. National Museum, Washington, D.C.

*Ichoronyssus robustipes* Ewing, 1925, Ent. News 36:20.

*Liponyssus chilensis* Ewing, 1925, Ent. News 36:21. New synonymy.

The type specimen is in poor shape but the sternal plate and the posterior body setae are clearly visible and they are typical *robustipes*. The specimen is from a bat, *Tadarida braziliensis*, taken in Chile, probably at Valparaiso. *Ichoronyssus robustipes* was described from *Tadarida mexicana*, a bat very similar, if not identical, to *Tadarida braziliensis*. The type is in the U.S. National Museum, Washington, D.C.

*Hirstionyssus cynomys* (Radford) and *Hirstionyssus occidentalis* (Ewing)

In the 1953 paper by Strandtmann and Morlan (Texas Reports on Biology and Medicine 11:637) it was stated that *Liponyssus cynomys* Radford is a synonym of *Hirstionyssus occidentalis* (Ewing). This was an error that was very kindly brought to the attention of the writers by Dr. E. W. Jameson of the University of California. In *Hirstionyssus occidentalis* (Ewing) the ventral spur on coxa II and the inner spur on coxa III are decidedly blunt. In *Hirstionyssus cynomys* (Radford) these spurs are longer and very definitely acute. Also, the sternal plate of *occidentalis* is longer than that of *cynomys*. *Hirstionyssus affinis* Jameson, 1950, is quite similar to *occidentalis*, differing only in having a shorter peritreme and a smaller posterior spur on coxa III.

*Hirstionyssus geomydis* (Keegan), 1946

Strandtmann and Morlan (ibid.) report that this mite lacks spurs on tarsus II. This is an error as it has two small, but distinct spurs.

## LAELAPTIDAE

*Laelaps multispinosus* Banks, 1909, Proc. Ent. Soc. Wash. 9:136.
*Liponyssus spiniger* Ewing and Stover, 1915, Ent. News 26:111. New synonymy.

The type specimen is in excellent condition. There can be no doubt that it is identical with Banks' species. Ewing had placed it in *Tetragonyssus* in 1922. The host was a muskrat, which is the type host of *multispinosus* Banks. Type specimen in the U.S. National Museum, Washington, D.C.

*Laelaps nuttalli* Hirst, 1915
*Liponyssus bermudaensis* Ewing, 1920, Ent. News 31:290. New synonymy.

The type specimen is in good condition. It was taken on "wood rat" in Bermuda. Type specimen is in the U.S. National Museum, Washington, D.C.

*Haemolaelaps sternalis* (Ewing). New combination.
*Ichoronyssus sternalis* Ewing, 1922. Proc. U.S. Natl. Mus. 62(13):13.

The specimen is stained and mounted in Dammar. The legs and mouth parts are folded and it contains an egg. Nevertheless, enough can be seen to show that it is a *Haemolaelaps*. The type specimen is in the U.S. National Museum, Washington, D.C.

*Hypoaspis smithii* Hughes, 1948 (Mites associated with stored food products. Ministry of Agric. and Fisheries, London. Page 132. January).
*Hypoaspis murinus* Strandtmann and Menzies, 1948, Ann. Ent. Soc. Amer. 41:479. [Not *Hypoaspis (Haemolaelaps) murinus* (Berlese), 1918.] New synonymy.

*Haemolaelaps megaventralis* (Strandtmann), 1947, Proc. Ent. Soc. Wash. 49:112.
*Hyposaspis freemani* Hughes, 1948, *ibid.* p. 129. New synonymy.

# A HESPERIID, *ATALOPEDES CAMPESTRIS*[1] (BDV.) AS A PEST OF BERMUDA GRASS PASTURES[2]

L. O. WARREN[3] AND J. E. ROBERTS[4]

The hesperiid, *Atalopedes campestris,* is considered to be the most common of all North American skippers and is found throughout the state of Arkansas (Freeman, 1945). Ordinarily hesperiids attract little attention and are seldom noted as economic pests. During July of 1955 considerable damage was done to Bermuda grass pastures in Crawford and adjacent counties by heavy larval infestations of *Atalopedes campestris.* A survey of the available literature did not reveal any detailed information on the habits of this species. Smith, et al, (1943), mentioned it as feeding on grass. The observations reported herein contribute some data on the behavior of this skipper as a pest of grass.

"Backyard" observations during early summer had shown the presence of numerous skipper larvae feeding on Bermuda grass. Although the number of larvae found averaged as many as 3 to 4 per square foot, no particular importance was attributed to the infestations because of the lack of background information. The first indication that infestations were causing damage was received in a letter with accompanying specimens from Crawford County, July 20, 1955, followed in quick succession by calls from the County Agent. Portions of the letter are quoted below.

"Mrs. M..... noticed the front porch covered with these things. She went out to sweep them off and found them on the brick walls too. Then she discovered that the action of the broom was too hard on their thin skins and they were smashed all over the place—leaving dark green spots on the concrete. She tried washing them off with the hose. While she was washing off the porch they were taking over the terrace. About that time I came in from the hayfield and started spraying. R..... did no good. A w.p. mixture of ..... seemed to hold them at bay but did not kill them too good. . . . We investigated and found the grassy area around the house full of the things. The next morning the news went out to the birds. We had birds and birds all day long. They ate and ate until they could hold no more. Our power lines were black with birds resting from over-eating. They helped cut down the worm population but they are still with us today though to a lesser degree than yesterday."

The quotation above is given in detail to illustrate three aspects of the infestations. First, the mass movement, as armyworm, of the larvae; second, the very heavy but localized nature of the infestations; and third, the mental anguish experienced by persons around whose homes or buildings heavy infestations and mass movement of the larvae occurred. In one instance an owner burned an old barn to destroy the great numbers of larvae

[1] Larvae identified by H. W. Capps, adults by W. D. Field.

[2] Published with the permission of the director of the Arkansas Agricultural Experiment Station.

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crawling in and around it! Numerous other reports were received concerning losses caused by the larvae. One stockman disposed of his beef herd earlier than planned because his pastures were temporarily ruined by larval feeding.

*Range of Infestations:* Damaging infestations were found from Pope County west to the Oklahoma line at Ft. Smith and north to Washington County. Larval forms and adults were observed in general over the state. It is likely that many locally heavily infested spots went unnoticed.

*Nature of Damage:* In general damage to pastures or lawns was limited to those predominantly of Bermuda grass. Light damage to dallis grass was noted. Other grasses were attacked only slightly or not at all. In Bermuda grass, the larvae consumed the leaflets, rarely the stem. Often a larva would make a pile of frass and bits of grass at the base of the grass stem. Larvae were observed upon the stem during the day but it is probable that most feeding occurred at other periods of the day. Concurrent infestations of grasshoppers *(Melanoplus* sp., *Hippiscus* sp.) caused severe damage to pasture in some areas.

*Movement of the Larvae:* Usually infestations were not noticed until pastures were denuded or when the mass movement of full-grown larvae began. Late in the period of activity as many as 50-75 larvae per square yard were observed migrating in the same general direction, south-southeast. All reports received indicated larval movement was always in this direction. The larvae would re-orient themselves in this direction when disturbed or picked up and headed in another direction. Daytime temperatures on bare soil, dirt roads and pavement caused considerable larval mortality. Hundreds of dead larvae often could be found in a short distance on such sites. Mass movement of larvae across heavily-traveled roads likewise resulted in mortality. The presence of a stream of water was no deterrent to larval migration. Literally thousands drowned in a small stream near Van Buren during a period of mass movement. A suitable explanation for the cause of this migration was not developed. In many instances areas of a pasture were left unharmed while the remainder would be denuded.

*Pupation:* The larva transforms to a naked pupa under cow chips, surface rocks, or in heavy herbaceous cover. Based on a single record, the pupal period lasts from 12-14 days.

*Adult Activity:* The adults, after emergence, tend to rest on or around herbaceous plants commonly found in pastures and fence rows. Bitterweed *(Helenium tenuifolium)* appeared to be very attractive to adults both as a resting site and as a source of food. An effort was made, without success, to determine something of the oviposition habits. Many females were observed alighting on a grass stem and going through movements suggestive of oviposition. In not a single instance was an egg recovered during such observations.

Adults were seen in great numbers near the heavily-attacked areas in late July and early August and diminshing numbers into the fall season. There was no indication of a second generation and larval forms were not

found after early August. Some parasitism by braconid wasps was noted in the field but no parasites were reared from larvae caged in the insectary.

*Summary:* A hesperiid, *Atalopedes campestris* (Bdv.) locally caused heavy damage to Bermuda grass pastures in the northwestern counties of Arkansas in 1955. The larvae, while not gregarious, moved in masses much as armyworms. This migration was characterized at all sites observed by movement in the same general direction. Pupation occurs in the field under protective cover of any nature. The pupal period lasted about two weeks under conditions prevalent in late July and August. Observations of adult behavior were inconclusive and unsuccessful in determining mating and oviposition habits. How the insect overwinters is not known.

LITERATURE CITED

Freeman, H. A. 1945. The Hesperiidae (Lepidoptera) of Arkansas. Field and Laboratory. 13(2): 60-64.

Smith, Roger C., et al. 1943. Insects in Kansas. Kan. St. Bd. Agri. Rept. 62(255): 257.

# INSECT FAUNA OF CUCURBIT FLOWERS[1]

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During the summers of 1952 and 1953 an investigation of cucurbit pollinators in Iowa was undertaken. The original intention was to devote the early period of the work to an analysis of the insect fauna, its variety, abundance and interrelationships and in later phases to investigate the predominant species as to their effectiveness as pollinators and their relationship to various environmental factors. Unfortunately the removal of both authors to different localities terminated the investigation. This report is essentially an analysis of the insects taken on cucurbit flowers at Ames, Iowa in 1952 and 1953. Although the information on *Lagenaria* is quite fragmentary, we feel that the principal insects involved in *Cucurbita* pollination have been well established and in view of the impossibility of carrying the investigation further have determined to publish our findings at this time.

The cucurbit species and varieties involved in this study were *Lagenaria siceraria* (Molina Bottle Gourd, Dipper Gourd and Maranka Club Gourd); *Cucurbita pepo* L. (Crown of Thorns Gourd, Spoon Gourd, Turks Turban Gourd and Bush Summer Crookneck Squash); *Cucurbita*

[1] Acknowledgment is made to H. M. Harris, Department of Zoology and Entomology and to E. S. Haber, Department of Horticulture, Iowa State College for making facilities available for parts of this study.

*maxima* Duchesne (Green Hubbard Squash, Buttercup Squash, and Golden Delicious Squash). Observations on the edible types were made primarily in commercial fields while observations on the ornamental varieties were made in a back yard garden.

It is generally considered that members of the Cucurbitaceae are pollinated almost exclusively by insects. The flowers of these plants possess certain adaptive morphological characters which fit them for this type of pollination. The most important of these features are: (1) heavy, large, adhesive pollen grains; (2) an adhesive stigma; (3) a large amount of high grade nectar; and (4) a large, showy corolla (Nevkryta, 1937).

Members of the genus *Lagenaria* may be either monoecious or dioecious while all *Cucurbita* plants are monoecious. The flowers of *Cucurbita* remain open for approximately 24 hours and the stigmas are receptive throughout this period and pollination usually takes place early in the morning soon after the flowers first open. The flowers of *Lagenaria* may remain open for a longer period, but they open in early evening and pollination is presumably accomplished at this time or during the night.

It has been rather commonly believed that the honey bee, *Apis mellifera* L., is the most important insect concerned with cucurbit pollination (Jones and Rosa 1928). However, a number of lists have been compiled showing that many other insects are also involved. The most extensive study appears to have been that of Nevkryta (1937), working in the Ukraine, who noted 63 species of Hymenoptera, 16 of Diptera, 7 Lepidoptera, 1 Hemiptera and 1 Coleoptera as occurring in or on *Cucurbita* and *Citrullus* flowers. Pammel & King (1930) consider the honey bee as the most important cucurbit pollinator in Iowa, although it is not included as a species collected on *C. pepo*. These authors listed a number of species of Hymenoptera on cucurbit flowers and considered *C. maxima* as attracting the greatest number of species. Robertson (1928) reported seven species of bees from *C. pepo* in Illinois. Durham (1928) found the striped cucumber beetle *Acalymma vittata* (Fabr.) to act as a pollinator of summer squash.

Pammel (1930) believed that *Lagenaria* flowers are best adapted structurally to pollination by crepuscular insects and hummingbirds and cited sphingid moths as possible pollinators. Our data though fragmentary do not seem to indicate this to be true in central Iowa. A long list of insects visiting *Lagenaria* in Germany was published by Knuth (1908).

The insects collected in Iowa during 1952 and 1953 are shown in Table I. The most abundant species are marked with an asterisk and the more important of these are analyzed in Table II. The relative attractiveness of the various plants to the more abundant insects is shown in Table III.

Members of the Hymenoptera and Coleoptera are predominately represented in the collections. The species belonging to these two orders make up 98 per cent of the total insects. Of these Coleoptera constitute 63 per cent.

### HYMENOPTERA

Although 24 species of Hymenoptera are represented, only two species

TABLE I. Insects collected from species of *Cucurbita* and *Lagenaria*. Ames, Iowa, 1952-1953.

| | *C. maxima* | *C. pepo* | *Lagenaria siceraria* |
|---|---|---|---|
| Coleoptera | | | |
| *Carpophilus brachypterus* (Say) | x | x | x |
| *Glischrochilus quadri-signatus* (Say) | x | x | |
| *Epicauta pennsylvanica* (Deg.) | x | | |
| **Diabrotica longicornis* (Say) | x | x | x |
| **D. undecimpunctata howardi* Barb. | x | x | x |
| **Acclymma vittata* (Fabr.) | x | x | x |
| *Epitrix cucumeris* (Harr.) | x | | |
| *Melanophthalma distinguenda* (Com.) | x | | |
| Diptera | | | |
| *Oscinella coxendix* (Fitch) | x | | |
| *O. abdominalis* (Beck.) | | x | |
| *O. minor* (Adams) | | x | |
| *Madiza setulosa* Mall. | | x | |
| *Megaselia* sp. | | x | |
| *Mesograpta marginata* (Say) | x | x | |
| *Scaptomyza graminum* (Fall.) | x | | |
| *Empis clausa* (Coq.) | x | | |
| *Tylomyza madizina* (Hend.) | x | | |
| *Saltella scutellaris ruficoxa* (Marg.) | x | | |
| Hymenoptera | | | |
| **Apis mellifera* L. | x | x | |
| **Xenoglossa s. strenua* (Cr.) | x | x | x |
| **Peponapis p. pruinosa* (Say) | x | x | x |
| *Bombus impatiens* Cr. | x | | |
| *B. americanorum* (F.) | x | | |
| *Melissodes bimaculata* (Lep.) | x | | |
| *Holcopasites calliopsidis* (Lins.) | x | | |
| *Augochlora striata* Prov. | | x | |
| *Agopostemon radiatus* (Say) | x | | |
| *A. viriscens* (F.) | x | x | |
| *A. texanus* Cr. | x | x | |
| *A.* sp. | x | x | |
| *Halictus c. confusus* Sm. | x | | |
| **H. zephyrus* Sm. | x | x | |
| *H. obscurus* Robt. | x | | |
| *H. forbesii* Robt. | x | | |
| *H. arcuatus* Robt. | x | | |
| *H. stultus* Cr. | x | | |
| *H. tegularis* Robt. | x | | |
| *H. versatus* Robt. | x | | |
| *H. cressonii* Robt. | | x | |
| *Meteorus vulgaris* (Cress.) | | x | |
| *Lasius niger neoniger* Em. | | x | |
| *Prenolepis imparis* (Say) | x | | |
| Hemiptera | | | |
| *Lygus lineolaris* (P. de B.) | x | | |
| *Adelphocoris rapidus* (Say) | x | | |
| *Orius insidiosus* (Say) | x | x | |
| *Jalysus spinosus* (Say) | | | x |
| Orthoptera | | | |
| *Melanoplus differentialis* (Thos.) | x | | |
| Thysanoptera spp. | x | x | |

*Insects most commonly collected

TABLE II. Percentages of predominant insect species collected from cucurbit flowers, Ames, Iowa, 1952-1953.

| | % of insects in order | % of total insects |
|---|---|---|
| Hymenoptera | | |
| *Xenoglossa s. strenua* (Cr.) | 18 | 6 |
| *Peponapis p. pruinosa* (Say) | 65 | 23 |
| *Apis mellifera* L. | 2 | <1 |
| Other | 15 | 6 |
| Total | | 35 |
| Coleoptera | | |
| *Diabrotica longicornis* (Say) | 18 | 11 |
| *Diabrotica undecimpunctata howardi* Barb. | 23 | 14 |
| *Acalymma vittata* (Fabr.) | 59 | 37 |
| Other | 10 | 1 |
| Total | | 63 |

TABLE III. Average number of the predominant species of insects per flower of *Cucurbita* and *Lagenaria*, Ames, Iowa, 1952-1953.

| Insect | *C. maxima* | *C. pepo* | *Lagenaria* |
|---|---|---|---|
| *Xenoglossa s. strenua* (Cr.) | 0.01 | 0.09 | 0.05 |
| *Halictus zephyrus* Sm. | 0.01 | <.01 | .... |
| *Peponapis p. pruinosa* (Say) | 0.23 | 0.07 | <.01 |
| *Acalymma vittata* (Fabr.) | 0.73 | 0.44 | 0.27 |
| *Diabrotica undecimpunctata howardi* Barb. | 0.23 | <.01 | 0.29 |
| *Diabrotica longicornis* (Say) | 0.81 | <.01 | 0.11 |

appear to be abundant enough to be important as pollinating agents. These are *Peponapis pruinosa pruinosa* (Say) and *Xenoglossa strenua strenua* (Cr.). Dr. Karl Krombein (in litt.) informs us that these species visit only cucurbits. *Peponapis pruinosa* alone makes up 65 per cent of the hymenopterous records and in this study it appears to be the most important bee pollinator.

The honey bee is represented by only two per cent of the Hymenoptera records and appeared to be an insignificant factor in pollination of these cucurbit varieties. The many reports of honey bees in cucurbit flowers could be explained by the fact that both *Peponapis* and *Xenoglossa* somewhat resemble honey bees and the casual observer could easily confuse them with this better-known insect.

### COLEOPTERA

The importance of these insects as pollinators is difficult to determine without detailed study. The predominant species are *Diabrotica longicornis* (Say), *Diabrotica undecimpunctata howardi* Barber and *Acalymma vittata* (Fabr.). The abundance of beetles would indicate that they probably play a considerable role in pollination. The last two beetles mentioned must, however, be considered serious pests of cucurbit crops because of their feeding habits and their acting as vectors of bacterial wilt.

A study was made in 1952 of the influence of these beetles upon the activities of bees. Six Golden Delicious and six Buttercup plants were selected for observation. Preliminary counts showed most bee activity between 9:00 and 11:00 a.m. and thus all subsequent counts were made during these hours. The total number of flowers and insect visitors were counted on July 18 and 23rd, and August 6th and 21st. Averages were then taken for each plant and the number of bees per flower plotted against the number of beetles per flower. The statistical analysis showed a significant inverse relationship in the case of the Golden Delicious squash and highly significant inverse relationship with the Buttercup squash.

This relationship seemed to be caused, at least in part, by an actual avoidance by the bees of flowers that contained beetles. A bee would alight on the edge of a flower and crawl or tumble inside. If only a few beetles were present feeding on the pollen, the bee shouldered its way in and began to gather pollen or nectar. However, if the beetles were very numerous, the bee turned about and sought a less heavily populated flower.

## SUMMARY

Field observations at Ames, Iowa of the flowers of two species of *Cucurbita* (seven varieties) and one species of *Lagenaria* (three varieties) showed 47 insect species present. Of these, species of Coleoptera and Hymenoptera constituted 98 per cent of the total number of individuals with *Diabrotica longicornis, D. undecimpunctata howard, Acalymma vittata, Xenoglossa s. strenua* and *Peponapsis p. pruinosa* being the dominant species.

The latter two species of bees appear to be the most important hymenopterous pollinators. The honey bee was seemingly an unimportant element in the pollinating fauna. The high numbers of cucumber beetles present in the flowers indicates a possibly important role in pollination. There was an inverse relationship between the number of beetles present in the flowers of selected squash plants and the number of bees that worked such flowers.

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## LITERATURE CITED

Durham, G. B. 1928. Pollen carriers on summer squash, *Cucurbita pepo*. Jour. Econ. Ent. 21: 436.

Jones, H. A., and J. T. Rosa. 1928. Truck Crops Plants. McGraw-Hill, New York, N. Y.

Knuth, P. 1908. Handbook of Flower Pollination. Vol. II, Oxford University Press, London.

Nevkryta, A. 1937. On the fauna and ecology of insect pollinators of the family Cucurbitaceae. Acad. Sci. R.S.S. Ukraine Inst. Zool. Biol. 14: 231-258.

Pammel, L. H. 1930. "Pollination" in Honey Plants of Iowa. Iowa Geol. Survey Bul. 7, pp. 863-966.

———, and C. M. King. 1930. "Cucurbitaceae, Gourd Family" in *Ibid*, pp. 650-662.

Robertson, C. 1928. Flowers and Insects. Privately printed. Carlinville, Ill.

# MUSCULATURE OF THE HEAD OF *AGULLA ADNIXA* (Hagen) (NEUROPTERA, RAPHIDIIDAE)[1]

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## INTRODUCTION

The purpose of this study is twofold. The first is to describe the musculature of the head, which was not done when Ferris and Pennebaker (1939) worked on the morphology of this species. Secondly, the present study aims at elucidating primitive points of origin of certain muscles in the insect head. The points of insertion of muscles seem to be fairly constant when they are inserted on appendages, but the shift of origins of muscles has been one of the most confused problems in insect morphology. It was noted in Ferris' and Pennebaker's work that anterior and posterior arms are clearly separated from each other in the species here studied. The musculature associated with the tentorium in this species is naturally expected to be more or less different from that of other insects in which both the anterior and posterior tentorial arms are well developed and fused with each other forming a "tent" beneath the epicranium. The present study was undertaken in a hope that comparison of these two types of musculature associated with two distinct types of tentorium may give some clue to the solution of the problem posed here.

## TECHNIQUE AND PROCEDURE

Dissection was made with two sharply pointed needles under a binocular microscope with magnification of 72x. The insect was imbedded in candle wax melted in a small jar, and the jar was filled with 90% alcohol. Van Giesen was used for the purpose of staining muscles.

As already noted, the external morphology of this species has been worked out by Ferris and Pennebaker, so a simple description of external structures with some additional information gained in this study for each head segment or region precedes the description of musculature.

## DESCRIPTIONS

### LABRUM (Pl. 1, fig. C)

The labrum is transverse subquadrangular in shape. There is no formation of a distinct epipharynx in this species. Its ventral surface is prolonged posteriorly and then articulated with the clypeus.

*Musculature:* The compressor muscles of the labrum (1, 2) are thin, short muscles extending between dorsal and ventral posterior margins of the labrum. The dorsal labral muscle (3) arises from near the inner margin of the apex of the hypopharyngeal suspensorium and is inserted near the middle of the dorsal posterior margin of the labrum. The lateral dorsal muscle (4) arises also from near the apex of the hypopharyngeal suspensorium and is inserted on the ventral posterolateral angle of the labrum at the point of articulation with the membranous inner surface of the clypeus.

[1] Contribution No. 939 from the Department of Entomology, University of Kansas.

### CLYPEUS (Pl. 1, fig. C)

The clypeus overhangs the labrum distally, its inner membranous surface being attached to the labrum. The clypeus in this species is a very simple structure; there is no subdivision into ante- and postclypeus. Posteriorly the clypeus is bordered by the epistomal suture which bears the anterior tentorial pit in front of the antennal cavity.

*Musculature:* The only muscle of the clypeus (5) arises from the apical margin of the hypopharyngeal suspensorium and is attached near the middle of anterolateral margin of the clypeus.

### ANTENNA (Pl. 1, fig. C)

*Musculature:* Three dorsal levator muscles (6, 7, 8) arise from the tip of the posterior tentorium, going obliquely dorsad to insert on the base of the scape of the antenna. The anterior tentorium projects between the two lateral muscles (7, 8). In the scape there are two antagonistic muscles, 9 and 10 (not shown in the text figure).

### MANDIBLE (Pl. 1, fig. C)

The mandible is provided with well developed apodemes, arising from the dorsal inner angle and outer ventral angle of the mandible respectively.

*Musculature:* The lateral mandibular extensor muscle (11) is inserted on the lateral apodeme of the mandible. It originates laterally and ventrally from the genal region of the cranium. The mesal mandibular flexor muscle (12) is inserted on the inner apodeme. The area of origin of this muscle occupies the greater part of the wall of the head capsule, including the vertex and genal regions. Ten bundles of muscle fibers are recognized dorsally.

### MAXILLA (Pl. 1, fig. B; Pl. 2, figs. A, C)

The maxilla conforms well to the generalized type. The cardo and the stipes are clearly separated by a membranous region. The stipes bears laterally the five segmented palpus and mesally the galea and the lacinia; the galea seems to be two segmented, but the muscle arising from the stipes inserts on the base of the apical division. The suture here suspected to be the occipital suture extends obliquely on the ventral surface from behind the ventral point of articulation of the mandible to meet with the postoccipital suture in front of the posterior tentorial pit. The postgenal region is thus represented by a small triangular region in this species. This suture was missed in previous work by Ferris and Pennebaker (1939).

*Musculature:* Two extrinsic muscles (13, 14) arise from the posterior tentorium. One (13) originates from the base of the tentorium and is inserted on the mesal posterior angles of the cardo. Another (14) arises from the tentorium beneath the preceding and is inserted on the mesal posterior angle of the stipes. There are four other extrinsic muscles of the maxilla in addition to the two originating from the posterior tentorium. Muscles 15 and 16 arise from the genal region lateral to the occipital suture and are inserted on the posterolateral angle of the stipes. The two muscles are confluent to each other at the point of insertion. Other extrinsic muscles

(17, 18) are slender, arising from the gular region, and are inserted on the base of the lacinia and on the mesal posterior angle of the stipes beneath muscle 14, respectively.

Intrinsic muscles: One muscle (19) arising from the posterolateral angle of the stipes inserts on the base of the lacinia. The base of the lacinia is

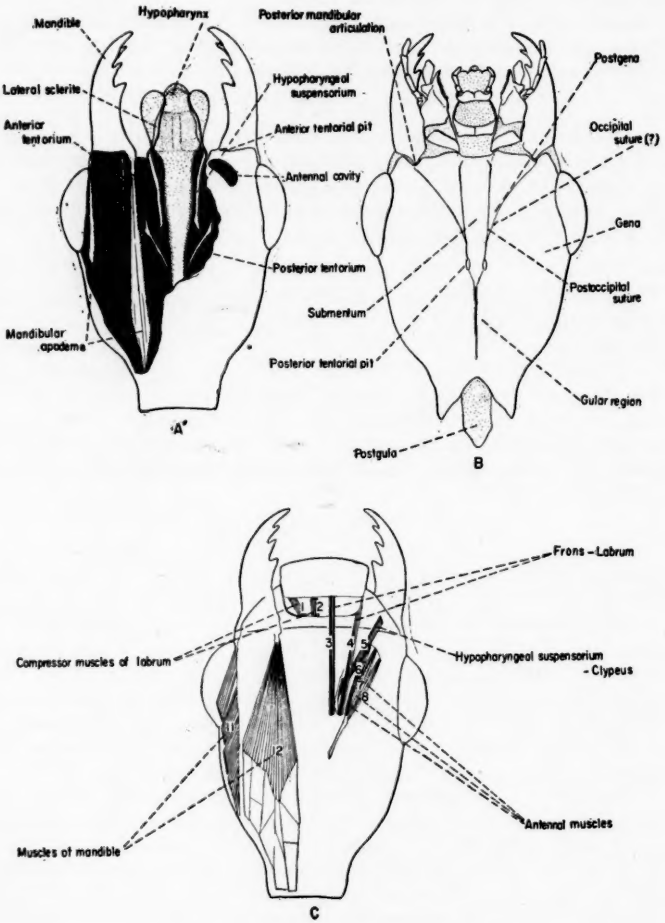


PLATE 1

A. Dorsal view of the head of *Agulla adnixa* showing the endoskeleton. B. Ventral view of the head. C. Muscles of the labrum, clypeus, antenna and mandible.

thus attached to two muscles, one intrinsic and one extrinsic (18). One thick muscle originating from the mesal posterior angle of the stipes inserts on the base of the apical segment of the galea. One muscle (21), arising from the mesal posterior angle of the stipes beneath the origin of the preceding muscle, inserts on the base of the first palpal segment. Two bundles of muscle fibers (22, 23) are recognized in the first palpal segment: the

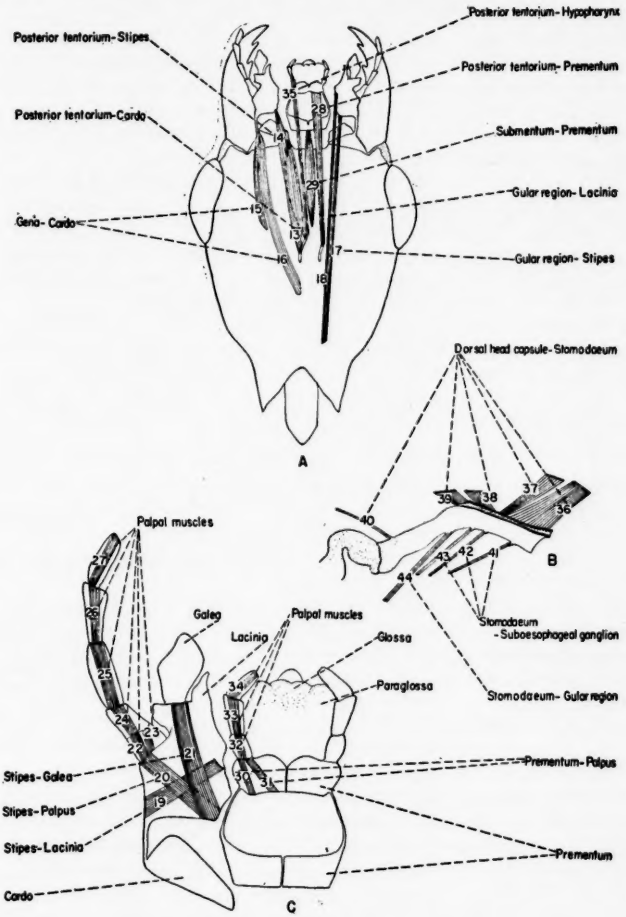


PLATE 2

A. Muscles of the maxillary and labial segments of *Agulla adnixa*. B. Muscles inserted on the stomodaeum. C. Intrinsic muscles of the maxillary and labial segments.

inner one attaches on the dorsal basal margin of the second segment; the outer one (22) attaches to the muscle of the second segment. Whether or not the muscles in the last four segments (24, 25, 26, 27) are differentiated, as Maki (1936) has shown, into two distinct bundles of fibers (levator and extensor) was impossible to determine by the techniques adopted in this study.

### LABIUM (Pl. 1, fig. B; Pl. 2, figs. A, C)

The submentum is anteriorly distinctly separated from the prementum and laterally it is limited by the postoccipital suture. The posterior tentorial pit can be seen a little behind the point of confluence between the occipital (?) and postoccipital suture. The prementum is composed of anterior and posterior plates; the latter is separated from the former by a membranous region, the posterior plate is folded on the anterior plate. Each plate is provided with a median longitudinal suture. The anterior plate bears the three-segmented palpus laterally. The glossa and paraglossa are completely fused, forming the membranous ligula. The gula is the region posterior to the posterior tentorial pit. A rather distinct longitudinal suture continuous with the postoccipital suture is recognized in this region. The postgula is the membranous region located behind the gular region.

*Musculature:* One extrinsic muscle (28) arises from near the apex of the posterior tentorium and is inserted on the posterior margin of the anterior plate of the prementum. Another extrinsic muscle (29) arises from the submentum and is inserted on the middle of the posterior margin of the posterior plate of the prementum.

### HYPOPHARYNX (Pl. 1, fig. A; Pl. 2, fig. B)

The hypopharynx is dorsally closely attached to the labium. The dorsal area of the hypopharynx is flanked on each side by a sclerite. The suspensorium is articulated with the proximal end of the lateral sclerite and extends dorsocaudally, tightly embracing the stomodaeum, thus giving a lateral support to the latter.

*Musculature:* The lateral sclerite bears a muscle (35) coming from the posterior tentorium above the origin of the muscle between the posterior tentorium and the anterior plate of the prementum (28). As already described, a muscle (5) extends between the apical region of the suspensorium and the clypeus.

### STOMODAEUM (Pl. 2, fig. B)

*Musculature:* Five dorsal muscles and four ventral muscles of the stomodaeum are recognized. Among the dorsal muscles, the anteriormost one (36) in the figure is a thick one originating from the clypeal region behind the posterolateral angle of the labrum. Another dorsal muscle (37) arises from just behind the preceding muscle. Muscles 38 and 39 insert vertically on the stomodaeum just inside the apical region of the hypopharyngeal suspensorium. The hindmost fine dorsal muscle (40) arises from the head wall far behind muscle 39. Three fine ventral muscles of the stomodaeum (41, 42, 43) are tightly attached ventrally on the suboeso-

phageal ganglion. The hindmost ventral muscle (44) is a little thicker than the preceding and is attached ventrally on the gular region mesal of the origin of the maxillary muscle going to the base of the lacinia (18).

## DISCUSSION

As was anticipated before working on this species, the musculature of the head shows a considerable deviation, due to separation of the anterior and posterior tentoria, from the general pattern seen in lower pterygote insect orders. The antennal muscles arise from the tip of the posterior tentorium. In adult insects the antennal muscles always arise from the dorsal arm of the anterior tentorium which arises, embryologically, from the mandibular segment (Riley, 1904) or from the base of the antenna (Heymons, 1895). Therefore, the condition seen in this species is apparently a secondary shift of origin from the anterior tentorium to the posterior tentorium due to reduction of the former.

A rather interesting thing is that no muscle is attached to the anterior tentorium; it simply projects among antennal muscles. The ventral adductor muscle of the mandible arising from the anterior tentorium in some Orthoptera, Odonata, Ephemeroptera and *Chauliodes* in Neuroptera (Maki, 1936) is apparently lost in this species.

Ventral muscles of the stomodaeum are usually attached on the tentorium, but in this species they are attached, instead, on the suboesophageal ganglion.

It is generally believed that the sclerites attached or articulated with the hypopharynx are composite in origin. The ventral muscle arising from above the origin of the labial muscle on the posterior tentorium is inserted on the distal lateral sclerite of the hypopharynx. Therefore, the sclerite is a labial sclerite as far as can be determined from the muscular arrangement; the suspensorium of the hypopharynx which is articulated with the lateral sclerite is a clypeal sclerite to judge by muscular arrangement, since the only muscle that is attached on this structure extends to the lateral margin of the clypeus. Hoyt (1952) concludes, on the basis of innervation in the cockroach, that the lateral sclerite (probably homologous with the lateral sclerite in *Agulla adnixa)* is labial, and the dorsal sclerite (suspensorium) is labral in origin. The extrinsic muscles arising from the basal region of the posterior tentorium are inserted on the maxillary cardo and the stipes respectively; one extrinsic muscle of the labium and the muscle of the hypopharynx arise from above the origin of maxillary muscles on the posterior tentorium. This arrangement of muscles is indicative that the apical part of the tentorium is labial and that the basal part of it is maxillary in origin. Chaudonneret (1951) came to the conclusion, on the basis of muscle attachments in *Thermobia domestica* (Thysanura), that the posterior part of the tentorium is maxillary and its anterior surface is labial in origin.

The muscular arrangement associated with the posterior tentorium in *Agulla adnixa,* which is clearly separated from the anterior tentorium, strongly substantiates the view held by Denis (1928), Badonnel (1934), and

Chaudonneret (1951) that the tentorium is produced as an intersegmental invagination (endophragma) between head segments. The extrinsic muscles of maxillary and labial segments arising from the posterior tentorium are evidently not the muscle transferred from the hypopharyngeal apodemes, as Snodgrass believes. Snodgrass' theory states that the hypopharyngeal apodeme in Chilopoda and some Apterygota is the gnathal sterna, and all ventral muscles of gnathal segments, including the muscles of mandible, maxillae, and labium, are primitively attached to this structure. With the shift (migration), totally or partly, of the apodeme first to the subgenal suture, then to the epistomal suture, and with consequent fusion with the posterior tentorium, all of these ventral gnathal muscles were transferred to the definitive tentorium. If we follow this interpretation to explain the musculature associated with the posterior tentorium in *Agulla adnixa,* we have to suppose that, after shift and fusion of the hypopharyngeal apodeme with the posterior tentorium, the primitive hypopharyngeal apodeme, which is now the anterior tentorium, has again retreataed anteriorly leaving the maxillary and labial muscles behind on the posterior tentorium. This is a highly complicated process which requires a considerable stretch of the imagination to visualize. It seems to be more reasonable to infer that the extrinsic muscles of the maxilla and labium arising from the intersegmental posterior tentorium maintain their primary segmental arrangement, rather than to suppose that they have been secondarily transferred to their present position.

The maxillary muscle or muscles are known to be attached to the anterior tentorium in some insects, but they are, when present, always located on the region of the tentorium caudal or lateral to the origin of the mandibular muscle, e.g. *Stenopsocus* (Badonnel, 1934), *Epiophlebia* (Asahina, 1954), Grylloblatta (Walker, 1931). When the mandibular muscle arising from the tentorium is lacking, the maxillary muscles arise from the posterior end of the anterior tentorium as in *Dissosteira* (Snodgrass, 1928). In the well formed tentorium, in which the anterior and posterior tentorial arms are completely fused, the border between the arms is hard to define, but the muscles seem to maintain their primary order of attachment at least in primitive groups of insects. An intersegmental or composite nature of the anterior tentorium has been maintained by French morphologists since Denis (1928), and the persistent muscles that are attached to the anterior tentorium in lower orders of pterygote insects are the mandibular and antennal muscles. If the anterior tentorium is an intersegmental structure as is the posterior tentorium, question would immediately arise as to just what segments are concerned for the production of this structure. Both embryological evidence (Heymons, 1895; Riley, 1904) and the musculature associated with the anterior tentorium strongly indicate that the mandibular segment and one more segment anterior to the mandibular segment including the antenna are responsible for the production of this structure. Badonnel (1934), believing that the anterior tentorium is a composite structure of the mandibular and tritocerebral segments, raises a difficulty in interpreting the attachment of the antennal muscles on the anterior tentorium.

Chaudonneret (1951) believes that the anterior tentorium, in *Thermobia domestica,* is the fusion product of pairs of intersegmental invaginations between the proto-deutocerebral, deuto-tritocerebral, tritocerebro-superlingual, superlinguo-mandibular, and mandibulo-maxillary segments. The oretically, the next segment anterior to the mandibular segment is the superlingual segment, and the theoretically primitive tentorial pair in question is, therefore, the intersegmental invagination between these two segments. Both Badonnel and Chaudonneret's interpretations fail to explain the actual muscular arrangement associated with the anterior tentorium in most primitive groups of pterygote insects. The only theory of the head segmentation that can explain this condition is that of Ferris and Henry which regards the antennocular segment as the segment lying immediately anterior to the mandibular segment. If we accept this view and the concept that the tentorium arises as an intersegmental invagination between head segments, which has been advanced by French morphologists, the anterior tentorium is simply the invagination between the mandibular and the antennocular segments, and the associated musculature becomes immediately concordant.

Apparently, the origin of the anterior tentorium is harder to explain than that of the posterior tentorium. One difficulty involved in the view here maintained is that it cannot possibly explain the origin of the hypopharyngeal adductor muscle of the mandible, which Snodgrass' theory can explain although it involves, at the same time, a highly imaginary process to explain the origin of the anterior tentorium, as noted previously. It seems, however, to be sounder to adhere to one mechanism (intersegmental invagination) to explain the similar structures (anterior and posterior tentoria) rather than to more than one as Snodgrass' theory does.

Supposing that the view here maintained is correct, the Chilopoda can no longer be considered as having the ancestral structure from which the insect tentorium has been derived. The search for the prototype of the insect tentorium should now be directed to some crustacean heads in which distinct sterna and intersegmental apodemes occur in gnathal segments as was adumbrated by Snodgrass (1928, p. 51).

Another peculiarity of the musculature associated with the posterior tentorium in *Agulla adnixa* is that the ventral prothoracic longitudinal muscle is attached on the postgula instead of the posterior wall of the posterior tentorium which is the case in most insects. Theoretically, the primitive point of attachment of this muscle, according to Chaudonneret (1951), is the labio-prothoracic tentorium arising from behind the posterior tentorium, which was found in Collembola (Denis, 1928), Psocoptera (Badonnel, 1934) and in Thysanura (Chaudonneret, 1951). Maki (1936) in *Chauliodes formosanus* and Kelsey (1954) in *Corydalus cornutus* found the same origin and insertion of the ventral prothoracic muscle as in *Agulla adnixa.*

Kramer (1955) discusses the musculature of the labial muscles and says that all distally inserted muscles originate from the tentorium. This is

true of *Agulla adnixa;* the only muscle originating from the posterior tentorium is inserted on the distal plate of the prementum.

## SUMMARY

1) The muscles of the head of *Agulla adnixa* (Hagen) are described.

2) The origin of the tentorium and its associated musculature are discussed. It is indicated that: a) Primitive points of origin of extrinsic maxillary and labial mucles arising from the definitive tentorium are in the region of the posterior tentorium. b) The anterior tentorium arises as an intersegmental invagination between the antennocular and mandibular segments, and primitively associated muscles are antennal muscles and mandibular muscle or muscles arising from the ventral region of the anterior tentorium (ventral adductor of the mandible).

## LITERATURE CONSULTED

Asahina, S. 1954. A morphological study of a relic dragonfly *Epiophlebia superstes* pp. 1-153, Pls. 70 Jap. Soc. Prom. Sci. Tokyo.

Badonnel, A. 1934. Recherches sur l'anatomie des psoques, Bull. Biol. France et de la Belgique, pp. 1-239.

Chaudonneret, J. 1951. La morphologie céphalique de *Thermobia domestica* (Packard), Insecte Apterygote Thysanoure, Ann. Sci. Nat. Zool. 11:145-302.

Comstock, J. and Kochi, C. 1902. The skeleton of the head of insects, Amer. Nat. 36:13-45.

Das, G. M. 1937. The musculature of the mouthparts of insect larvae, Quart. Jour. Micr. Sci. 80(1):39-80.

Denis, J. 1928. Sur l'anatomie de la tête de quelque Collemboles, Arch. Zool. Exp. Gen. 68:1-291.

Dorsey, C. 1943. The musculature of the labrum, labium and pharyngeal region of adult and immature Coleoptera, Smiths. Misc. Coll. 103(7):1-42.

Ferris, G. and Pennebaker, P. 1939. The morphology of *Agulla adnixa* (Hagen) (Neuroptera. Rhaphidiidae) Microentomology 4(5):121-142.

Henry, L. 1948. The nervous system and the segmentation of the head in the Annulata, Microentomology 13(2):27-48.

Heymons, R. 1895. Die embryonale Entwicklung von Dermapteren und Orthopteren. Jena, pp. 1-136.

Hoyt, C. 1952. The evolution of the mouthparts of adult Diptera, Microentomology 17(3):61-125.

Hudson, G. B. 1945. A study of the tentorium in some orthopteroid Hexapoda, Jour. Ent. Soc. South. Africa 8:71-90.

Hudson, G. B. 1947. Studies in the comparative anatomy and systematic importance of the Hexapod tentorium. II. Dermaptera, Embioptera and Isoptera, Jour. Ent. Soc. South Africa 9:99-110.

Hudson, G. B. 1948. Studies in the comparative anatomy and systematic importance of the Hexapod tentorium. III. Odonata and Plecoptera, Jour. Ent. Soc. South Africa 9:38-49.

Hudson, G. 1951. Studies in the comparative anatomy and systematic importance of the Hexapod tentorium, IV. Ephemeroptera, Jour. Ent. Soc. South Africa 14:2-23.

Imms, A. D. 1939. On the antennal musculature of insects and other arthropods, Quart. Jour. Micr. Sci., 81:273-320.

Janet, C. 1899. Essai sur la constitution de la tête de l'insecte, pp. 1-74.

Kelsey, L. 1954. The skeleto-motor mechanism of the Dobsonfly, *Corydalus cornutus,* part I. Head and prothorax, Cornell Univ. Agric. Exp. St. Mem. 334:1-51.

Kramer, S. 1955. The musculature of the head of the *Corydalus larva* (Neuroptera. Sialidae) Jour. Micr. Sci. 96(1):1-30.

Maki, T. 1936. Studies on the skeletal structure and nervous system of the alderfly *Chauliodes formosanus* Peterson, Mem. Fac. Sci. and Agric., Taihoku Imp. Univ. 16(3):117-243.

Miller, F. W. 1933. Musculature of the lacewing *(Chrysopa plorabunda)* Neuroptera, Jour. Morph. 55:29-52.
Riley, W. 1904. The embryological development of the skeleton of the head of *Blatta,* Amer. Nat. 38(455-456):778-810.
Rober, H. 1941. Morphologie des Kopfes und des Vorderdarmes der Larve und Imago von *Sialis flavilatera,* Zool. Jahrb.. (Anat. u. Ontg.), 67(1):61-118.
Snodgrass, R. 1928. Morphology and evolution of the insect head and its appendages, Smiths. Misc. Coll., pp. 1-158.
Snodgrass, R. 1935. Principles of insect morphology.
Snodgrass, R. 1950. Comparative studies on the jaws of mandibulate Arthropods, Smiths. Misc. Coll. 116:1-85.
Snodgrass, R. 1951. Comparative studies of the head of mandibulate Arthropods. pp. 1-118.
Strenger, A. 1952. Die funktionelle und morpholigsche Bedeutung der Nahte am Insektenkopf. Zool. Jahrb. 72, 3/4, pp. 468-521.
Walker. E. 1931. On the anatomy of *Grylloblatta campodeiformis* Walker, 1. Exoskelton and musculature of the head, Ann. Ent. Soc. Amer. 24(3):519-536.

# A SYNOPSIS OF THE TACHINID GENUS *LEUCOSTOMA* (Diptera)[1]

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The genus *Leucostoma* was proposed by Meigen in 1803 without the designation of a type; however, in 1824 he referred one species, viz., *Ocyptera simplex* Fallen, to the genus thereby validating it twenty-one years after the original citation.

*L. simplex* was originally described from Sweden and seemingly is a fairly common species on the European continent. The salient characters of the genotype do not differ in any decisive details from the common new world *Leucostoma atra* Townsend (equals *Paradionaea atra* Townsend). Although no detailed study of the type specimens involved has been possible for a complete report herein, all available European and American material has been re-examined critically with special reference to genitalic features. The results of these comparisons have failed to disclose any items of salient differences between the American and the available European material. The common American *L. atra* therefore falls as a synonym of *L. simplex;* which has a wide range in the principal zoogeographical regions of the world.

In the United States no member of the genus apparently has been encountered as a common parasite of any host. All rearings hitherto recorded indicate that the host relationships are exclusively with the true bugs or Hemiptera. Also, it may be added that local collections extending over the past forty years have not yielded large numbers of any species indicating further that perhaps no *Leucostoma* species is an important local factor in the natural control of any hemipterous host.

As here considered *Leucostoma* includes thirteen nominal species of which twelve are briefly distinguished in the accompanying key and more

[1] Contribution No. 2399, from Department of Entomology, Texas Agricultural Experiment Station.

fully characterized on the following pages. With few exceptions all members are small shining black, moderately bristled flies, which differ in some details in genital structures and to a lesser extent than usual in other external features.

The more distinctive characters of the genus may be summarized as follows: ocellar bristles reclinate; lunule setose; antenna short extending a little below mid face; arista short, with small proximal segments; clypeus only slightly depressed; parafacial bare; eye large, reaching well below vibrissal level; first posterior cell closed with long petiole reaching costa before extreme wing tip; calypters strikingly enlarged in male and female with a pair of horizontal pincer-like cerci at the tip of the abdomen.

The remaining characters which apply to the members of the genus collectively are summarized for ready reference immediately below to avoid repetition of details under the descriptions which follow.

Frontal profile one-third to one-half longer than facial; frontals in a single row with two bristles in advance of antennal base; outer verticals and proclinate orbitals in female, absent in male; cheek sublinear in profile; antenna small, two apical segments subequal in length; arista bare, slightly thickened near base; epistoma as wide as clypeus and gently bowed forward from plane of same; short decussate vibrissae set well above oral margin; facial ridge flattened and bare; parafacial hardly narrowed downward and somewhat wider than third antennal segment; proboscis usually distinctly shorter than head height; palpus slender, tip barely thickened; occiput flattened on upper part and slightly bulged below middle, sparsely black-haired. Thoracic chaetotaxy: acrostichal 1 or 2, 1; dorsocentral 2, 3; presutural 1 (outer); humeral 2; sternopleural 3; pteropleural 1 (small); scutellum with 2 stoutish lateral and 1 decussate apical of somewhat smaller size, no discals; prosternum, propleuron and postnotal slope bare. Male claws and pulvilli subequal to length of apical tarsal segment, shorter in female. Wing longer than abdomen especially in male; hind cross vein midway between small cross vein and cubitulus; last section of fifth vein at most two-fifths length of preceding; costal spine vestigial; calypters usually smaller in female than in male, white and sharply contrasting with dark body color. Abdomen variable with sex; obovate in male, slightly narrower and longer than thorax with a dorsal vestiture of more or less erect hairs, in female the hairs are shorter and appressed on intermediate segments above, and the anal segment bears a distinctive pair of forceps-like appendages with each inwardly bowed arm usually beset with a series of minute teeth on inner margin and terminating in a short spine; one pair of median marginals on segments one and two (sometimes with an incomplete marginal row on first and a complete row on second); last two segments each with a marginal row but much weaker on anal segment in female; latter sex with genitalia terminating in a short retracted needlelike piercer; male genitalia quite similar in general structure throughout the species here included; hypopygium largely retracted; forceps somewhat variable in width at base and degree of reduction in width towards apex; accessory process always small and inconspicuous, usually triangular in shape and

without any striking vestiture; claspers long and prominent, with sclerotized base of penis protruding rearward from latter thence jointed, bowed forward and pale membranous to tip.

I am indebted to Curtis W. Sabrosky for the privilege of including the U.S. National Museum material in the present study and all types based upon the latter are returned to the aforementioned institution. Only a few of the species herein defined are represented in good series and the status of the others must be considered provisional until more adequate material becomes available.

## Genus *Leucostoma* Meigen

*Leucostoma* Meigen, 1803, Illiger's Mag. 2:279 (no species).
*Leucostoma* Meigen, 1824, Syst. Beschr. 4:234 (type, *Ocyptera simplex* Fallen); 1910, Coquillett, Proc. U.S. Natl. Mus. 37:561; 1934, Aldrich, Diptera of Patagonia & South Chile, Pt. 7, fasc. 1, p. 28; 1938, Townsend, Manual of Myiology, Pt. 7, 189-190.
*Clelia* Robineau-Desvoidy, 1830, Essai Myodaires, 255 (type, *C. agilis* R-D equals *Musca aterrima* Villers).
*Psalida* Rondani, 1856, Dipt. Ital. Prodr. 1:76 (1 species in error); ibid., 4:91 (type, *Ocyptera simplex* Fallen).
*Calyptidia* Robineau-Desvoidy, 1863,, Hist. Nat. Dipt. 2:59 and 920 (type, *Calyptidia occlusa* Robineau-Desvoidy).
*Cyclodionaea* Townsend, 1915, Jour. N.Y. Ent. Soc. 23:233 (type, *Cyclodionaea acuminata* Townsend).
*Siphopsalida* Townsend, 1916, Proc. U.S. Natl. Mus. 49:439 (type, *Siphopsalida meridionalis* Townsend).
*Paradionaea* Townsend, 1916, ibid., p. 631 (type, *Leucostoma atra* Townsend).
*Neopsalida* Townsend, 1916, ibid., p. 632 (type, *Leucostoma neomexicana* Townsend).
*Parapsalida* Townsend, 1916, ibid.. p. 632 (type, *Phyto nigricornis* Townsend).
*Aequia* Malloch, 1930, Proc. Linn. Soc. New South Wales 55:325.

## KEY TO SPECIES OF *LEUCOSTOMA*

1. Male (unknown in *meridionale, peruvianum,* and *vapulare)* ..... 2
   Female (unknown in *nimirum, vegetum* and *peccator)* .....10
2. Abdomen with one or more segments distinctly pollinose ..... 3
   Abdomen without pollen or wholly shining; calypters greatly enlarged; palpus yellow and second antennal segment tinged with red (Europe, North and South America, Australia) .....*simplex* (Fallen)
3. Abdominal pollen confined to basal half or less of last three segments 4
   Abdominal pollen not as described ..... 5
4. Hairs on upper surface of abdomen erect; head pollen tawny; genital forceps gradually narrowed to near tip, beak much shorter than wider basal part (Peru) .....*vegetum,* n. sp.
   Hairs on intermediate abdominal segments appressed; head pollen silvery; forceps tapering sharply to middle leaving a slender curved beak which is as long as broader basal part (North America) .....
   .....*acirostre,* n. sp.
5. Frontal lunule bare ..... 6
   Frontal lunule setose ..... 7
6. Frontal vitta obviously wider than parafrontal except on anterior extremity; calypters enlarged; abdominal hairs erect and entire surface of last three segments above dusted with opaque gray pollen (Puerto

Rico) ..... *nimirum*, n. sp.
Frontal vitta much narrower than parafrontal; calypters not noticeably enlarged; abdominal hairs appressed, upper surface moderately shining but with greenish gray pollen on segments two to four extending thinly to hind margin of each (Brazil) ..... *peccator*, n. sp.

7. Fore tibia with one median posterolateral bristle ..... 8
Fore tibia with two posterolateral bristles; frontal vitta wider than parafrontal which is lightly dusted with gray pollen on a blackish subshiny background; last three abdominal segments thinly gray pollinose; calypters not much enlarged (U.S., Mexico) ..... *gravipes* van der Wulp

8. Parafacial at most with a few setae beneath lowermost frontals ..... 9
Parafacial with black hairs extending downward about to middle of face; calypters strongly widened; last three abdominal segments pollinose to hind margin (Utah) ..... *effrenatum*, n. sp.

9. Three sternopleural bristles; abdomen usually broadly truncate at apex; genital forceps with a broadish base which is concave behind and tapers sharply to middle thence slender or beaklike to tip (western U.S.) ..... *perrarum*, n. sp.
Two sternopleurals; abdomen narrowed to apex, last two segments silvery pollinose; genital forceps rather narrow, gradually tapering from base to apex and transversely rounded or convex on hind side (Europe, North and South America, Puerto Rico) *aterrimum* (Villers)

10. Abdomen ordinary in form, segments two and three much broader than long ..... 11
Abdomen longer and narrower than usual, tapering gradually from base to apex; sternopleurals three; arms of anal forceps strongly bowed inward and bearing a series of minute teeth on ventral edge of inner margin ..... *aterrimum* (Villers)

11. Abdomen without pollen or wholly shining black ..... 12
Abdomen with silvery pollen on narrow basal margin of intermediate segments; haustellum subequal to head height; calypters moderately enlarged, opaque white; forceps rather slender, strongly bowed inward and beset with only fine hairs on inner margin ..... *acirostre*, n. sp.

12. Fore tibia with one median posterolateral bristle ..... 13
Fore tibia with two posterolateral bristles; cheek nearly one-fourth eye height; calypters not enlarged; forceps strongly bowed inward with a series of stubby dentations on inner ventral edge ..... *gravipes* van der Wulp

13. Haustellum moderately stout, usually under two-fifths head height ..... 14
Haustellum very slender or nearly filiform, three-fourths head height; epistoma elongate, bowed forward; forceps meeting apically at an acute angle, without teeth on inner margin (Peru) ..... *meridionale* (Townsend)

14. Fourth abdominal segment emarginate on apical edge ..... 15
Fourth abdominal segment transverse on hind margin, glabrous over most of upper surface, which is evenly convex, calypters enlarged;

cheek one-tenth eye height; forceps denticulate on inner margin .... ..... *simplex* (Fallen)
..... *peruvianum* (Townsend)

15. Frontal vitta much narrower than parafrontal ..... 16
Frontal vitta equal to or wider than parafrontal; arm of forceps rather short, wide at base, tapered to an acute upturned tip; fourth abdominal segment flattened above from middle of base outwardly to apex; calypters large ..... *effrenatum*, n. sp.

16. Forceps almost equibroad from base to tip in profile and about half as long as anal abdominal segment; latter setiferously punctate on upper surface except on basal edge; palpus yellow ..... *perrarum*, n. sp.
Forceps short and inconspicuous, distinctly narrowed from broadish base to tip in profile; anal abdominal segment glabrous on upper surface except narrow apical margin; palpus brown to blackish with tip paler (California) ..... *vapulare*, n. sp.

### *Leucostoma simplex* (Fallen)

*Ocyptera simplex* Fallen, 1820, Dipt. Suec. Musc., p. 8.

*Leucostoma simplex* (Fallen), 1824, Meigen, Syst. Beschr. 4:234; Coquillett, 1910, Proc. U.S. Natl. Mus. 37:561; Malloch, 1930, Proc. Linn. Soc. New South Wales 55:323.

*Leucostoma atra* Townsend, 1891, Trans. Amer. Ent. Soc. 18:380; Coquillett, 1897, Revis. Tachin., p. 68-69; Aldrich, 1934, Diptera of Patagonia & South Chile, Pt. 7, fasc. 1, p. 28-29.

*Paradionaea atra* (Townsend), 1916, Proc. U.S. Natl. Mus. 49:631; West, 1928, N.Y. State List, p. 810; Townsend, 1938, Manual of Myiology, Pt. 7, p. 192-193.

The more important references to this species in American literature are cited above. It is the commonest member of the genus and has a wide range throughout the temperate and tropical regions of both northern and southern hemispheres. The material available for study included 234 specimens from many different localities throughout the United States besides a very limited series from Central and Eastern Europe. Only one of the specimens was accompanied by any rearing or biological data.

The characters of the species (genotype) have been reviewed by various workers and descriptions are readily accessible. Also, most pertinent anatomical details of *simplex* may be gleaned from the summarization, in previous paragraphs, of the generic limits as here considered. The principal color items of the species among others are listed below.

MALE. Head pollen subsilvery; parafrontal pollinose to vertex, with one or two rows of erect hairs outside of frontal bristles; second antennal segment and sometimes base of third reddish in ground color, remainder of segments black; cheek thinly pollinose, sublinear; palpus yellow; haustellum polished brown, barely one-half head height. Thorax shining black with a whitish bloom apparent in some angles, humeri more definitely pollinose, mesonotum not vittate, clothed with erect but short black hairs. Legs black, rather slender but not noticeably elongated; claws and pulvilli hardly as long as last tarsal segment. Wing clear; veins including costa yellow; petiole of first posterior cell fully half as long as apical cross vein; cubitulus obtuse, without stump or fold; last section of fifth vein about one-third

length of preceding; epaulet black; calypters widened, opaque white and contrasting sharply with black body color. Abdomen shining black without a trace of pollen, vestiture on upper surface usually decumbent; hypopygium black, small and retracted; forceps fused, tapering to a short acute-tipped apical beak which is gently bowed forward in profile; sternites covered.

FEMALE. Similar to male except for sexual differences; anal segment of abdomen largely glabrous above and shorter than preceding segment; forceps rather slender, tapering outward from base and slightly upturned apically with inner ventral margin of arms denticulate.

Length, 3.5-5 mm.

Shannon (Proc. Wash. Ent. Soc. 16:182) recorded one specimen reared from *Nabis (=Reduviolus) roseipennis* Reuter, on May 10, 1914, at Washington, D.C. Mundinger (N.Y. State Coll. Forestry, Tech. Publ. No. 16, pp. 149-168) also reported the species as parasitizing the same host. In the U.S. National Museum one specimen with puparium attached bears the following data: Columbus, Wis., July 17, 1925 (Chas. L. Fluke), parasite of *Nabis ferus* (L.).

### *Leucostoma peruvianum* Townsend

*Leucostoma pernviana* Townsend, 1927, Rev. Chil. Hist. Nat. 31:159.
*Paradionaea peruviana* (Townsend), 1938, Manual of Myiology, pt. 7, p. 193.

The type specimen (female) is in the U.S. National Museum. I have not seen it. According to Townsend (loc. cit.), Aldrich erroneously redescribed this species as *Leucostoma atra* Townsend (Diptera of Patagonia and So. Chile, pt. 7, fasc. 1, p. 28-29). The latter description is brief and none of the items listed show decisive differences from *L. simplex* Fallen (=*L. atra* Townsend). Also, it should be stated that Townsend failed to cite any of the alleged differences here. The *peruvianum* type specimen has the forceps more noticeably thickened towards the base than in *simplex* and apparently this is the principal distinction hitherto noted. The status of *L. peruvianum* cannot be determined at this time; more material from the type locality, including the male sex, is essential for a detailed comparative analysis.

### *Leucostoma aterrimum* (Villers)

*Musca aterrima* Villers, 1789, Ent. Linn. 3:548
*Leucostoma neomexicana* Townsend, 1892, Can. Ent., 24:169; Coquillett, 1903, Proc. U.S. Natl. Mus., 25:109; Aldrich, 1905, Cat. N.A. Diptera, p. 438-439.
*Cyclodionaea acuminata* Townsend, 1915, Jour. N.Y. Ent. Soc. 23:234.
*Neopsalida neomexicana* Towsend, 1916, Proc. U.S. Natl. Mus. 46:632; 1938, Manual of Myiology, Pt. 7, p. 191-192.
*Leucostoma aterrima* (Villers) Aldrich, 1934, Diptera of Patagonia & South Chile, Pt. 7, fasc. 1, p. 29.

The species is sexually dimorphic in build and the difference in general appearance of the female from the normal habitus of the allied forms is quite striking. The abdomen, in this sex compared with the male, is much more elongated and slender, tapering gradually from base to apex which bears the usual characteristic forcepslike cerci. Each abdominal segment approximates its maximum width (at base) but the fourth segment may be telescopically retracted within the preceding and for this reason sometimes appears considerably wider than long. In other details, except as noted in

the accompanying key, the female of *aterrimum* differs little from the corresponding sex in *simplex*.

MALE. Head subsilvery pollinose; front at vertex 0.20 of head width, equibroad to middle thence rapidly widening to antennal base; parafrontal thickly clothed with erect longish black hairs; verticals not differentiated, ocellars and frontals rather weak; thorax and scutellum shining black, chaetotaxy as listed above; calypters enlarged, reaching about to hind margin of first abdominal segment; claws and pulvilli elongate; abdomen shining black with last two segments wholly gray pollinose and third sometimes less conspicuously so; hairs on entire upper surface long and erect, none differentiated as discals; one pair of median marginal bristles on each basal segment and a marginal row on last two; hypopygium retracted in repose; small first segment blackish, second somewhat paler; fused forceps evenly arched in profile, convex behind, gradually tapered from rather narrow base to a smooth or polished apex; sternites covered.

FEMALE. Vertex 0.34 of head width, front widening gradually into facial angle; two pairs of verticals and proclinate orbitals; parafrontal with only a few scattered setae outside of frontal row; three sternopleural bristles; calypters large but much smaller than in male; claws and pulvilli short; abdomen wholly shining black, with a vestiture of short appressed hairs above; anal cerci rather slender, arms strongly bowed and bearing a row of small stubby teeth on lower inner margin.

Length, 4-5.5 mm.

Both sexes have been collected together locally and there seems little doubt that they are correctly associated as characterized above. However, it should be stated that reared material is not currently available as supporting evidence to this conclusion. Townsend's restricted genera, viz., *Cyclodionaea* and *Neopsalida* are based upon the female and male, respectively, of the present species. The Chilean material which Aldrich assigned here (loc. cit.) was compared by him with a male from Europe determined by Bezzi. A female from Nimes, France in the U.S. National Museum likewise agrees closely with the available American material, except in the latter the second antennal segment is usually more or less reddish in ground color and the vestiture of the first abdominal segment is frequently erect along median line above. These items, which may also prove variable in Old World material, hardly seem sufficient to signify a specific segregate here.

*Leucostoma meridionale* (Townsend)

*Siphopsalida meridionalis* Townsend, 1916, Proc. U.S. Natl. Mus. 49:439; 1938, Manual of Myiology, Pt. 7, p. 196-197.

This species was described (female only) from Peru as the type of *Siphopsalida* and hitherto no additional material has come to light. Among the characters listed for the species the slender elongate proboscis, long ventral profile of head and prominent epistoma indicate a close relationship with *acirostre* as described herein. The descriptions of *meridionale* in the citations listed above are readily accessible and details need not be repeated here. The principal items among others which, according to descriptions, distinguish *meridionale* from *acirostre* are as follows:

FEMALE. Haustellum slender, fully three-fourths head height; facialia as wide as parafacialia; cheek one-sixth eye length; abdomen wholly shining and without pollen, third segment not narrowed but as long as wide, fourth segment not emarginate at apex, glabrous except a few fine short hairs behind; arms of forceps curved meeting at an acute angle; costal spine short but distinct; petiole of first posterior cell about as long as hind cross vein; calypters normal in size, tawny white.

Holotype female, San Diego, Casma, Peru, April 7, 1912 (C. H. T. Townsend) in the U.S. National Museum.

*Leucostoma acirostre,* n. sp.

The present species name was first suggested by Coquillett many years ago as evidenced by a specimen in the U.S. National Museum collection so labeled in the latter author's own hand. Unfortunately the species was never published under this name but in deference to an eminent pioneer American dipterist it is here applied as originally intended for this long known but hitherto unnamed interesting little fly.

MALE. Head pollen silvery on black background; front at vertex 0.20 of head width, equibroad to middle thence widening forward into facial angle; frontalia deep brownish to black, at middle subequal to width of parafrontal; latter with about two irregular rows of fine erect black hairs outside of frontal bristles; antenna black with an obscure reddish tinge in ground color of basal segments; faciale flattened and narrower than parafaciale which exceeds one-half clypeal width; epistoma more strongly produced or prominent than in most allied forms; proboscis exceeding head height, haustellum slender, subequal to eye length, labella as long as third antennal segment and very slender; palpus subfiliform, bearing two or three small black hairs near slightly thickened tip; cheek about one-twelfth eye height. Thorax black, lightly dusted with gray pollen which leaves traces of four dark vittae before the suture in favorable light; scutellum shining black and clothed with fine erect black hairs; postscutellum normally developed, pruinose. Legs black, claws and pulvilli longer than apical tarsal segment. Wing clear; veins yellow, third with one small hair near base; calypters considerably enlarged, opaque white; epaulet and subepaulet black. Abdomen shining black with basal third to half of last three segments silvery pollinose; one pair of stoutish median marginal bristles on first and second segments and a complete marginal row on last two; no discals; genital segments shining black; forceps transversely rounded on triangular base behind which bears a vestiture of fine hairs, narrowed distal beaklike part glabrous and gently bowed as viewed in profile; fifth sternite small and mostly covered.

FEMALE. Vertex 0.34 of head width; two pairs of strong verticals and proclinate fronto orbitals, ocellars also stouter than in male; frontalia much narrower than one parafrontal; pollen on abdomen confined to the narrow basal edge of each intermediate segment, fourth segment much shorter than preceding one which is slightly emarginate on posterior ex-

tremity; forceps not denticulate on inner margin of arms which prescribe an almost perfect circle as viewed from above.

Length, 4.5-5.5 mm.

Holotype male, "Brownsville, Texas, April 29, Townsend"; allotype female, College Station, Texas, October 29, 1933 (H. J. Reinhard) in the U.S. National Museum. Paratypes: New Jersey, 1 male, Woodbury, June 7, 1896; Maryland, "1 male, July"; 1 male, Plummer's Island, October 28, 1913 (R. C. Shannon); 1 male, Chevy Chase Lake, August 14 (C. H. T. Towsend); Virginia, 1 male, Louisa, October 8, 1923 (J. M. Aldrich); 1 male, Falls Church, August 12, 1917 (Charles T. Greene); District of Columbia, Washington, 1 male, May 30, 1947 (Wm. E. Hoffmann) reared from adult of *Harmostes? reflexulus* (Say); Indiana, Lafayette, 1 male and 1 female, July and August, (J. M. Aldrich); Mississippi, 1 male, Starkville, June 9, 1921 (H. W. Allen); 1 female, "N. Albany, September 28, 1921"; 1 female, "Tupelo, September 27, 1921"; 2 males, Agr. Coll., May 28, 1922 (H. W. Allen); Texas, 9 males and 2 females, April-October, 1918-1942 (H. J. Reinhard); 1 male, Quinlan, September 17, 1955 (W. Downes); 1 male, Smithville, May 12, 1954 (R. H. & L. D. Beamer); New Mexico, 1 male, Mesilla Val., August 1921 (C. H. T. Townsend); 1 female, Arizona, Eloy, May 21, 1955 (T. R. Haig); 2 males, 3 mi. E. Pearce, July 10, 1955 (G. Butler & F. Werner) Lepidium; California, 1 female, Mt. Diablo, May 22, 1954 (P. D. Hurd); Borego, San Diego Co., 11 males and 4 females, April 24-28, 1955 (P. D. Hurd, M. Wasbauer, R. Schuster); Idaho, 4 males and 1 female, Moscow, July-September, 1908-1910 (J. M. Aldrich); Washington, 1 male, "Pullman" and 1 female "Wash."

*Leucostoma vegetum*, n. sp.

Closely allied to the preceding species from which it differs mainly as follows:

MALE. Head pollen pale satiny yellowish gray; vertex 0.22 of head width; parafrontal with one row of short black hairs outside of frontals; frontalia deep reddish brown, wider than one parafrontal on upper half; antenna black; epistoma bowed forward from clypeal plane but not so prominent as in *acirostre;* vibrissae set a little above oral margin; cheek narrow, almost sublinear in profile. Thorax indistinctly pollinose except pleura and humeri which appear silvery in favorable light, mesonotum not vittate. Abdomen feebly shining black, last three segments with gray pollen on basal half which extends thinly to hind margin on each when viewed in a flat rear angle; hairs on entire upper surface erect but short; genital forceps gradually tapered to about apical fifth thence somewhat compressed into a short glabrous beak which is gently bowed and terminates in an acute tip. Female unknown.

Length, 5 mm.

Holotype, Sullana, Peru, February 12, (C. H. T. Townsend) in the U.S. National Museum.

*Leucostoma nimirum*, n. sp.

Similar to *acirostre* except as follows:

MALE. Head pollen dark gray or plumbeous; front at vertex barely one-fifth head width, slightly narrowed before ocelli and widening to two-fifths head width at antennal base; frontalia velvety black, wider than one parafrontal, which bears about two rows of erect hairs outside main frontal row; antenna wholly black; vibrissae near oral margin; epistoma gently bowed forward from clypeal plane, not very prominent; cheek quite narrow or sublinear in profile; labella slender and exceeding length of third antennal segment. Thorax shining black above with sides of prescutum silvery and pleural region less distinctly so, not vittate before suture. Claws and pulvilli about as long as last tarsal segment. Calypters translucent tawny white. Last three abdominal segments with gray pollen above which extends from base to apex on each but rather thinly so behind middle on segments two and three, each of latter bearing a complete row of marginal bristles; hypopygium small, largely retracted; fused genital forceps decidedly shorter and narrower than usual, tapering from base to an acute gently curved tip, with a vestiture of soft black hairs on hind surface which is transversely convex; fifth sternite covered. Female unknown.

Length, 4-5 mm.

Holotype, "Havana, Cuba, Baker", collection J. M. Aldrich, in the U.S. National Museum. Paratypes: 1 male, same data as type; and 1 male, Itaquaquecetuba, Brazil, May 30, 1941 (H. L. Parker) Sapl. No. 304-135.

*Leucostoma perrarum*, n. sp.

A rather variable species averaging a little larger in build than most other allied forms; abdomen thinly pollinose and usually broadly truncate in male.

MALE. Parafrontal silvery, usually with one or two rows of erect black hairs outside of frontal bristles but sometimes much more extensively haired; front at vertex 0.20 of head width, diverging rapidly forward below middle; frontalia deep reddish brown, narrower than one parafrontal; parafacial silvery, bare below lowermost frontal and subequal to about one-half clypeal width; antenna black, second segment more or less reddish and but little shorter than third; cheek sublinear in profile; haustellum five-eighths head height; palpus brownish to yellow. Thorax and scutellum shining black with a whitish bloom over most of surface and appearing much denser in a flat front angle; chaetotaxy about as summarized above except the sternopleuron bears three well differentiated bristles. Claws and pulvilli elongated. Wing hyaline with a slight yellowish tinge; costal spine minute or vestigial; calypters distinctly widened, opaque white. Abdomen shining black, with thin but distinct pale pollen on at least segments three and four; last segment usually with a very broad or truncated apex and obviously shorter than the preceding; hairs on upper surface variable, usually more or less appressed but sometimes rather long and erect in the available series; hypopygium small and usually more or less completely retracted within the large anal orifice; forceps moderately broad at base which is concave behind and rather strongly narrowed distally to near middle thence slender and beaklike to tip; claspers reddish, fused basally,

free part of anterior pair longer and bowed forward at tip; fifth sternite retracted.

FEMALE. Two specimens are provisionally included here; neither has been definitely associated with any male of the type series. Front broad, at vertex 0.34 of head width; outer verticals about as long as inner; two proclinate orbitals; frontals and ocellars stouter than in male; frontalia black, much narrower than parafrontal, latter nearly bare outside frontal row; claws and pulvilli short; apex of fourth abdominal segment emarginate; forceps not denticulate on inner margin.

Length, 5-6.5 mm.

Holotype male. Duchesne, Utah, August 23, 1928 (G. F. Knowlton). Paratypes: Utah, 1 male, Monticello, 9-5-37 (G. F. Knowlton); Nevada, 1 male, "Purdy, Washoe Co. 8-18-53"; Arizona, 1 male, "Yuma, 9-3-31" and 1 male "Ariz. Sept."; California, 3 males, Kelseyville, Lake Co. 9-1-53 (E. I. Schlinger) and 1 male, San Antonio R. S. Santa Clara Co. 6-27-53 (R .O. Schuster); 1 female, Borego, San Diego Co. 4-28-54 (J. G. Rozen); Oregon, 1 male, Medford, Jackson Co. 9-9-53 (A. T. McClay); 1 female, Hampton, 6-24-54 (G. F. Knowlton) and 1 female, Eagle Point, Jackson Co. 9-8-53 (A. T. McClay).

Differences within the type series in the vestiture of the parafrontals and abdomen among others as mentioned above may indicate a mixture of species here. Present material is not adequate to determine the extent of specific variation.

*Leucostoma effrenatum*, n. sp.

MALE. Differs from all other known members of the genus in having the upper half of parafacials hairy; parafrontals also bearing a heavier than usual vestiture of longish erect hairs. Vertex 0.17 of head width equibroad on upper third thence rapidly widening into facial angle; cheek nearly one-sixth eye height; calypters enlarged; claws and pulvilli moderately elongated; abdomen pollinose over most of upper surface but more conspicuously so on apical segments, the latter as well as the two basal ones bearing a row of marginal bristles; hairs fully half as long as bristles and erect; genital forceps as described under preceding species but less strongly tapered and terminating in a much shorter beak.

FEMALE. One example from the general type locality may belong here. Similar to male except for sexual differences; the wide frontalia, flattened anal abdominal segment and tapered or pointed upturned forceps, as mentioned in the accompanying key, seem quite distinctive.

Length, 6 mm.

Holotype male, Logan Dry Canyon, Utah, May 26, 1949 (Wilford J. Hanson). Paratype: 1 female, Elsinore, Utah, July 22, 1937 (G. F. Knowlton).

*Leucostoma vapulare*, n. sp.

A small rather compactly built species in which the female has short thick non-prominent forceps; abdomen arched in profile, anal segment

subequal to length of the preceding, with upper surface evenly convex and largely glabrous.

FEMALE. Head pollen gray to subsilvery; front moderately broad, at vertex 0.28 of head width; two pairs of verticals and proclinate orbitals; ocellars reclinate, not very strong; frontalia black, narrower than parafrontal; latter with a few scattered hairs outside frontal row; parafacial bare and but little narrowed below; antenna black, second segment subequal to length of third; vibrissae slightly above oral margin; haustellum nearly two-thirds eye height; palpus brown, moderately thickened apically; cheek one-ninth eye height, sparsely short-haired; back of head slightly bulged about neck and below. Thorax shining black, mesonotum lightly pale pollinose, faintly vittate before suture; chaetotaxy as mentioned above. Legs shining black, rather short and stoutish; claws and pulvilli much shorter than apical tarsal segment. Wing gray hyaline, reaching a little beyond tip of abdomen; veins blackish, third bearing one small hair near base; petiole of first posterior cell about two-thirds length of apical cross vein; costal spine vestigial; calypters opaque white, not noticeably widened or enlarged. Abdomen wholly shining black, without any pollen; hairs on upper surface appressed; first segment with one pair of median marginal bristles, segments two to four each with a complete marginal row but very weak or hairlike on last; venter concave in profile, apical sternite rather broadly exposed and shining black. Male unknown.

Length, 3.5-4 mm.

Holotype, Sagehen, nr. Hobart Mills, California, June 25, 1954 (E. I. Schlinger). Paratype, 1 female, same data as type, collected by R. M. Bohart.

### *Leucostoma gravipes* van der Wulp

*Leucostoma gravipes* van der Wulp, 1890, Biologia Centr. Am. Dipt. 2:207.
*Phyto senilis* Townsend, 1892, Can. Ent. 24:81; 1908, Tax. Musc. Flies, p. 76-77.
*Phyto nigricornis* Townsend, 1892, Can. Ent. 24:170.
*Parapsalida nigricornis* (Townsend), 1916, Proc. U.S. Natl. Mus. 49:632.
*Leucostoma gravipes* van der Wulp, 1934, Aldrich, Diptera of Patagonia & South Chile, Pt. 7, fasc. 1, 28.

This species averages larger in build than any of the other forms here included and its general habitus does not approximate that of the genotype very closely. However, the genitalia of the two species are quite similar in structure and there is close agreement in some other pertinent details as indicated below.

MALE. Front distinctly narrowed above middle, vertex 0.27 of head width; parafrontal moderately shining black but with thin grayish pollen apparent in favorable light; frontal vitta reddish brown to black, considerably wider than parafrontal; outer verticals about half as long as inner; ocellars rather strong, reclinate; basal antennal segments reddish, third black and little longer than second; clypeus hardly depressed, facial ridge flattened and beset with four or five hairs next to vibrissae; latter a little above oral margin; cheek nearly one-third eye height; proboscis subequal to head height; palpus yellow, slender, hardly at all thickened distally; occiput moderately bulked about neck and below. Thorax shining black

with a slight whitish bloom apparent on pleura and mesonotum; chaetotaxy about as listed above, but scutellum with a third (hindmost) lateral well differentiated. Legs black, stoutish, femora somewhat enlarged; fore tibia with two posterolateral bristles; claws and pulvilli elongated. Wing subhyaline; petiole of first posterior cell about two-thirds length of apical cross vein and reaching costa well before wing tip; hind cross vein joining fourth about its length from cubitulus; latter obtusely angular, without stump or fold; third vein with one small hair near base; costal spine small; calypters opaque white, moderately widened; epaulet infuscated. Abdomen moderately shining black with a brownish tinge apparent at sides, entire upper surface except basal half of first segment lightly sprinkled with gray pollen; a marginal row of good-sized bristles on each segment but row interrupted on first and sometimes on second segment; hairs on upper surface erect but short; hypopygium small and largely retracted; fused forceps shining brown, tapering to apical third, base behind nearly glabrous and transversely convex, beak short, compressed and bowed forward in profile; claspers united basally, from which the chitinized base of the penis is directed rearward thence curved forward in the arc of the forceps and terminating in a soft pale membrane; accessory process infuscated, small and inconspicuous; sternites covered.

FEMALE. Front at vertex 0.32 of head width; two pairs of proclinate frontals and outer verticals nearly as strong as inner; abdomen wholly shining black, without pollen; basal segments each with one pair of median marginal bristles; anal forceps slender, strongly bowed inward, denticulate on inner margin.

Length, 4-7 mm.

The type series of *Phyto nigricornis,* from Las Cruces, New Mexico, is in the University of Kansas collection. I examined the holotype in December, 1944. The species is widespread in the United States ranging from New York to Idaho and California southward to Texas and Mexico.

A related species, *L. brasiliana* Townsend (Rev. Ent., 1938, 6), was reared from *Oncopeltus* sp. in Brazil. This form was not represented in the material available for the current study.

*Leucostoma peccator,* n. sp.

This is an aberrant form in the present genus but is assigned here provisionally because it approximates the general habitus of the genotype; also, it agrees with the latter in having reclinate ocellars, large bare eyes, small antennae, long petiolate first posterior cell, etc.

MALE. Front wider than usual, at vertex 0.36 of head width and nearly equibroad forward to antennal base; parafrontal, ocellar triangle, parafacial, cheek and posterior orbit all with heavy pale yellowish gray pollen; frontal vitta deep red, less than one-half parafrontal width; outer verticals three-fourths length of inner; antenna black, third segment slightly longer than second; vibrissae about on oral margin; bare arista short and slender beyond the moderately thickened basal third; epistoma bowed forward from clypeal plane, but not very prominent in profile; cheek about one-

sixth eye height; proboscis subequal to head height; palpus yellow, slender but slightly thickened apically; occiput ashy gray, moderately convex below and flattened above. Thorax and scutellum black, moderately dusted with gray pollen; chaetotaxy as summarized above except only two posterior dorsocentral bristles (middle one absent in the one specimen). Legs black, fore tibia with one posterolateral bristle; claws and pulvilli equal or exceeding length of last tarsal segment. Wing hyaline with a light yellow tinge costobasally; petiole of first posterior cell subequal length of apical cross vein, reaching costa a little before extreme wing tip; hind cross vein straight and nearly perpendicular to fourth which it joins about midway between small cross vein and cubitulus; third vein with one small hair near base; costal spine small but distinct; calypters tawny white, ordinary in size. Abdomen dusted with moderately heavy greenish gray pollen on basal two-thirds or more of last three segments, remainder of each blackish and subshining; hairs on entire upper surface short and depressed; genital segments black, gray pollinose; forceps short and terminating in separated obtuse tips, between and in front of the latter is a reddish slender compressed, chitinized rod bowed forward from its apparent attachment on hind side of the fused claspers; fifth sternite with a broad U-shaped median incision, lobes shining black, largely retracted. Female not known.

Length, 5 mm.

Holotype "Brasilien, Nova Teutonia, 27° 11′ B., 52° 23′, L. 25-9-1937, Fritz Plaumann." This locality is in Santa Catarina, Brazil.

## NEW HOST RECORDS FOR NORTH AMERICAN SPIDER-WASPS (Hymenoptera: Pompilidae)

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The following spider-wasp host records for seven genera (nine species) of our North American Pompilidae are offered at this time since it is believed that such information will prove to be of valuable assistance in subsequent biological and systematic considerations of this family of wasps. Previously there were no records for North American representatives of the genera *Paracyphononyx, Priocnemioides* and *Priocnessus,* and new host records are presented for the genera *Ageniella, Anoplius* and *Auplopus.*[1]

We are indebted and indeed very grateful to Dr. Willis J. Gertsch, American Museum of Natural History, for the identification of the spider material. His remarks concerning each of the species of spiders, where applicable, have been incorporated. Professor H. K. Townes, University of Michigan, kindly identified the spider-wasps of the genus *Ageniella.* The arrangement below is that employed by the Synoptic Catalog of the Hymenoptera of America north of Mexico.

[1] The Mexican records were obtained during the course of an expedition sponsored by Associates in Tropical Biogeography, University of California.

*Priocnemioides unifasciatus cressoni* (Banks)

Host: *Lycosa antelucana* Montgomery (Lycosidae), female.

Collection data: Southwestern Research Station, American Museum of Natural History, Chiricahua Mountains, near Portal, Arizona, July 20, 1955 (W. J. Gertsch).

*Priocnessus* sp.

Host: *Euagrus* sp. (Dipluridae), female. This is an adult and identifiable; it could be *empiricus* Chamberlin, which is based on a few specimens from Mulege, Lower California.

Collection data: Ahuacatlan, Nayarit, Mexico, July 18, 1951 (Hurd).

*Priocnemis oregona* Banks

Host: *Brachythele* sp. (Dipluridae), immature female. This could be *longitarsis* Simon, but without careful revisionary study of the group identification is not possible.

Collection data: Isabella Creek, Mt. Hamilton, Santa Clara County, California, April 19, 1956 (D. Burdick).

*Auplopus architectus metallicus* (Say)

Host: *Thiodina* n. sp. (Salticidae), penultimate males. This new species was previously reported from California and the entire southwest as *sylvana* Hentz.

Collection data: Lafayette, Contra Costa County, California, November 9, 1948 (E. G. Linsley) and Oroville, Butte County, California, January, 1956 (R. O. Schuster).

*Agenıella conflicta* Banks

Host: *Lycosa rabida* Walckenaer (Lycosidae), juvenile.

Collection data: none.

*Ageniella fuscipennis* Townes

Host: *Oxyopes salticus* Hentz (Oxyopidae). This spider has a wide distribution from southern New England across into California and abounds in Mexico and the American Tropics. Spiders of this family are vagrants which run over the vegetation.

Collection data: Hopland Field Station, University of California, Mendocino County, California, July 13, 1955 (Wasbauer).

*Anoplius americanus juxtus* (Cresson)

Host: *Peucetia viridans* Hentz (Oxyopidae).

Collection data: Alpuyeca, Morelos, Mexico, June 26, 1951 (Hurd).

*Anoplius ventralis tarsatus* (Banks)

Host: *Tarentula kochi* Keyserling (Lycosidae), female.

Collection data: Berkeley Hills back of University of California, March 26, 1954 (J. W. MacSwain).

*Paracyphononyx funereus* (Lepeletier)

Host: *Lycosa lenta* Hentz (Lycosidae), female.

Collection data: Newman's Lake, near Gainesville, Florida, June 19, 1935 (W. J. Gertsch).

# THE GENUS *RHOPALOSYRPHUS*, WITH A DESCRIPTION OF A NEW SPECIES FROM ARIZONA (Diptera, Syrphidae)[1]

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Although the genus *Rhopalosyrphus* has been mentioned in North American literature and included in keys at various times, it has never been recorded from the United States prior to this date. Members of the genus are exceedingly rare; only five specimens comprising three species are known, all from the Western Hemisphere. *Rhopalosyrphus guntherii* (Arribalzaga) has been taken at Chinantla, Mexico and Buenos Aires, Argentina, both specimens females. One female of *R. auricinctus* Sack has been taken at St. Trinidad, Paraguay. A male and female of *R. carolae* n. sp. have been taken at Sunnyside Canyon, Huachuca Mountains, Arizona. These collecting localities show the genus to be subtropical in distribution, no specimens having yet been taken in the equatorial zone.

In September, 1891, Giglio-Tos described the genus from the Chinantla, Mexico specimen but failed to name the type species. In October, 1891, Arribalzaga described the *Holmbergia guntherii* apparently from the same species which Giglio-Tos had before him. The following year Giglio-Tos acknowledged the validity of Arribalzaga's type species but pointed out that his description of the genus preceded Arribalzaga's generic description by somewhat less than a month. Giglio-Tos' generic description was supported by two cuts, one of the head in profile and one of the abdomen.

Phylogenetically the genus stands between *Mixogaster* Macquart and *Microdon* Meigen, all three members of the subfamily Microdontinae Verrall. All have a porrect, somewhat elongate antenna with a basal, bare arista. In *Rhopalosyrphus carolae* the third antennal segment is turned outward at a right angle to the first and second segments. This is the case in both the male and female and appears to be the natural position for that segment, as in *Microdon* and certain of the Stratiomyidae.

The scutellum of *Rhopalosyrphus* is armed with spines, occasionally only emarginate. The third vein usually emits a stump into the first posterior cell and the anterior cross vein is near the base of the discal cell. *Rhopalosyrphus* differs basically from *Mixogaster* by the presence of the stump vein extending into the apical cell and from *Microdon* by a distinctly spatulate abdomen.

Because of their close relationship to *Microdon* and a superficial resemblance to the family Crabronidae, Arribalzaga believed the genus *Rhopalosyrphus* to be parasitic in the nests of these wasps. Although this assumption is possibly correct, there has been no observation to validate the theory.

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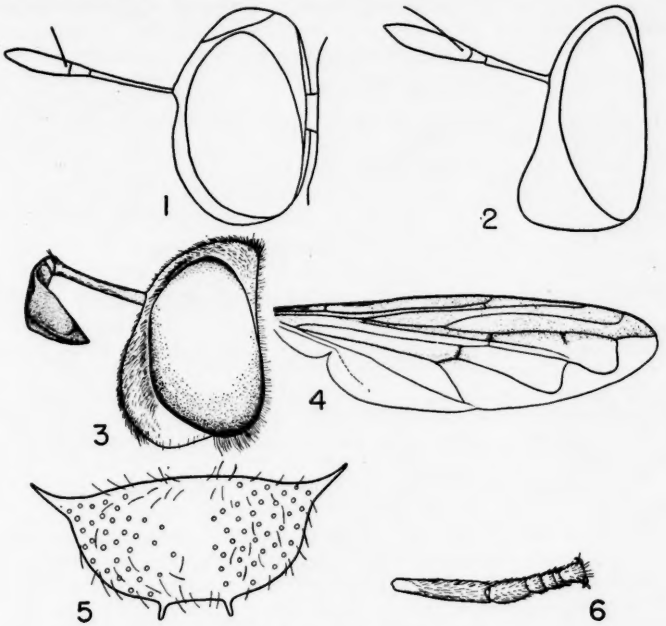
[1] Contribution number 944 from the Department of Entomology, University of Kansas.

[2] I wish to thank Dr. C. L. Fluke of the University of Wisconsin and Dr. C. D. Michener of the University of Kansas for helpful suggestions and loan of material for this study.

Mimicry among insects through the process of natural selection is common and does not necessarily imply a direct relationship between the mimic and the model. It may be pointed out that although some members of the *Volucella* complex resemble their *Bombus* hosts, so do members of the genera *Criorrhina, Mallota* and certain species of *Eristalis,* which do not inhabit *Bombus* nests.




EXPLANATION OF FIGURES

1. *Rhopalosyrphus auricinctus* Sack, female, head in profile (redrawn from Sack, 1921).
2. *R. guntherii* (Arribalzaga), female, head in profile (redrawn from Giglio-Tos, 1891).
3. *R. carolae,* new species, female, head in profile. 4. *R. carolae,* wing of female.
5. *R. carolae,* scutellum of female. 6. *R. carolae,* anterior tibia and tarsi of female.

## *Rhopalosyrphus* Giglio-Tos

*Rhopalosyrphus* Giglio-Tos, 1891, Bollettino Universita Torino 6(108):3.
*Holmbergia* Arribalzaga, 1892, Annales de la Sociedad cientifica Argentina 34:251.
*Rhopalosyrphus* Williston, 1892, Biologia Centrali-Americana Insecta, Diptera 3:78.
*Rhopalosyrphus* Hull, 1949, Transactions of the Zoological Society of London 26:312.

Type species: *Holmbergia guntherii* Arribalzaga, 1891, Annales de la Sociedad cientifica Argentina 32:197.

The genus *Rhopalosyrphus* is distinguished from *Mixogaster* by the presence of a stump of vein extending into the apical cell and from *Microdon* by the spatulate abdomen.

Face convex, pilose; eyes bare, dichoptic in both sexes. Antennae inserted above middle of eyes, porrect, first segment cylindrical and thin, at least as long as third segment, second segment brief, somewhat cup-shaped.

Third segment lanceolate, laterally compressed. Arista long, naked, inserted at outside base of third antennal segment. Thorax stout, scutellum wide and short. Abdomen spatulate rather than clavate as in *Mixogaster,* and dilated posteriorly, the sides not parallel after the segments broaden.

Legs stout, feet short, hind femora posteriorly dilated, tarsi sometimes dilated. Marginal and submarginal cells open, third vein with stump of vein extending into the apical cell; anterior cross-vein placed well before middle of discal cell.

## KEY TO SPECIES

1. Face convex below bases of antennae ..... 2
   Face straight or slightly concave below bases of antennae, becoming convex and snout-like below ..... *guntherii*
2. Margin of face evenly parallel to margin of eye ..... *auricinctus*
   Margin of face not evenly parallel to margin of eye, wider below..... ..... *carolae,* new species

### *Rhopalosyrphus guntherii* (Arribalzaga)

Fig. 2

*Holmbergia guntherii* Arribalzaga, 1891, Annales de la Sociedad cientifica Argentina 32:197.

*Rhopalosyrphus guntherii* Giglio-Tos, 1892, Bolletino Universita Torino 7(118):1.

*Rhopalosyrphus guntherii* Giglio-Tos, 1892, Memoirs Royal Academy of Science, Torino 43:131.

Arribalzaga's description is translated as follows: "Dark black, opaque, finely, closely punctate, thinly white silken-haired. First antennal segment shining, base reddish-black, apex dark black; remaining two dark black, opaque, light grey-dusted, bristles black.

"Wings transparent, iridescent, divided throughout their length, the front black, second basal cell obscurely darker at the edge.

"Anterior and middle legs chestnut brown to darker rusty-red, tarsi completely pitch black with white, silky hair. Hind femora pitch black, base rusty-red. Posterior tibiae basally widened. Posterior tarsi dark below, yellow-reddish tomentose. Anterior tarsi dilated in the female.

"Abdomen dark black above, yellowish silky haired, especially dense to apex, third segment tube-like on both sides, rusty brown, apical segment ventrally black."

Length 12 mm.

Habitat: Buenos Aires, Argentina.

Location of type unknown.

Giglio-Tos' description is translated as follows: "Female—Body oblong, head wider than thorax, front of face equally spread, inclined obliquely forward, epistome projects like a bump without extending beyond the lower part of the eyes. Front as large as the face, slightly narrower at top. Ocellar tubercle raised, placed in middle of the front before the line which connects the posterior margin of the eyes. Three ocelli, equidistant, hardly visible. Eyes large, separated, bare. Antennae almost as long as head and thorax together, excluding the scutellum; inserted above the middle of the eyes. First segment cylindrical and thin, as long as the third segment.

Second segment very short and cup-shaped, third segment is wide and oblong-ovate, compressed. Right antenna is destroyed. Arista almost as long as third antennal segment, thin, naked and inserted at outside base of third antennal segment.

"Thorax quadrangular. Scutellum wide, almost semi-circular, short. Abdomen wide at base, pedicellate in the middle and ending clavate. First segment is wide as the scutellum and short. Second segment is wide as the thorax at its base and becomes smaller toward its end. Third segment very narrow at the base and slightly larger apically. Fourth segment is wide as the thorax and concave. Fifth segment is cone-shaped with the apex cut and is concave below.

"Wings—Marginal cell open, fourth longitudinal vein straight and appendiculate toward the end of the first posterior cell. Subcostal vein is before the middle of the median cell, rather close to the base.

"Legs—Short, posterior femur thickened in the middle. Posterior tibiae thickened at the apex. First segment of posterior tarsi is wide and long."

Length 14 mm. Length of wing 10 mm.

Habitat: Chinantla, Mexico.

It is possible that the Mexican and Argentine specimens represent distinct species.

### *Rhopalosyrphus auricinctus* Sack

Fig. 1

*Rhopalosyrphus auricinctus* Sack, 1921, Archiv für Naturgeschichte. Vol. 87, Abteilung A, Heft 3, p. 148.

Similar to *Rhopalosyrphus guntherii* but differs in the form of the lower part of the face and in the presence of gold-yellow hair bands.

The following is adapted from Sack's description.

#### FEMALE

Vertex strong and polished, dark brown. Antennae similar to *R. guntherii,* first segment is dark brown. Face equally broad, edges of eyes parallel. Two very fine longitudinal lines parallel to the eyes in the region of the convex face.

Front and face are rusty red, with short gold pile. The short palpi are rusty red.

Thorax dull black, finely punctured, with very pronounced sides which are rusty red with close-lying gold-yellow hairs beneath these sides. A small, fine, transverse, gold-yellow hair band, one longitudinal hair band anteriorly, and the third band before the scutellum. Humeri also golden.

Pleura at the suture with long silvery spots of hairs. The scutellum has two small, close set teeth, and is covered with yellow silky hairs. Halteres are dark brown. First pair of legs are light reddish-brown, tibia on basal half whitish and haired. The hind legs are brownish-black. Two-thirds of the base of the hind tibiae are whitish. Hind femora are spindle-shaped and on the outer surface near the middle is a longitudinal band of white silken hairs.

Wings grey, somewhat cloudy so that the longitudinal and occasionally the cross veins are surrounded by brown. A larger brown spot is found on the small cross vein.

Abdomen pedicellate so that the second segment is smaller than the adjacent segment and is especially strongly narrowed towards the middle. Segments three to five form a spindle, their lateral edges very strongly turned under.

The abdomen is black and covered with very fine punctures. Second abdominal segment is a bright rust brown laterally. On the posterior margins of the abdominal segments are golden hair bands which turn forward medially and form two fine parallel longitudinal bands. Ventrally the abdomen is black.

Length 14 mm.

One female from St. Trinidad, Paraguay.

Location of type unknown.

*Rhopalosyrphus carolae* new species

Figs. 3-6

This species differs from *R. auricinctus* by a stronger produced facial region below the antennae and from *R. guntherii* by a front narrower than the face and the epistoma less produced and snout-like below.

FEMALE

*Head:* Vertex and front black, polished, finely punctate, thinly pilose. Ocellar triangle prominent, slightly less than half the distance from occiput to base of antenna. Ocelli amber, approximately equidistant. A slight prominence on vertex posterior to ocelli. Occiput concave, grey pollinose. Face convex, swollen below, black punctate, with slight violet iridescence. Face evenly covered with silver hairs except in area immediately surrounding bases of antennae. Epistome indented laterally on either side of oral opening. Eyes ovate, large and bare. Margin of occiput fringed with silver hairs, becoming longer below the eyes. Antennal base large, polished, triangular and more prominent above. First antennal segment cylindrical, porrect, slightly constricted in the middle; basally brown, translucent, becoming dark brown to black apically. Second segment brief, black, cup-shaped. Third segment long, ovate, laterally compressed, appearing deflated; black, velvety-pubescent, turned outward and drooping. Arista long and bare, inserted laterally at base of third antennal segment.

*Thorax:* Black, punctate, less polished, thinly haired dorsally, with three transverse gold bands. The first band behind the pilose humeri, the second at the transverse suture, the third wider and more golden, just anterior to scutellum. Hair on pleurites and tergites silver. Scutellum black, punctate, hairy, with two small spines pointing upward and outward. Space between spines approximately equal to the sum of their lengths. First and second pair of legs brown, whitish at bases of tibiae, and considerably shorter than third pair. Fore tarsi not dilated. Anterior femora conspicuously bowed. First and second femora with a conspicuous brown patch of setulae on their bases anteriorly. This region is defined on the posterior

femora but the thick setulae are absent. Hind legs considerably elongated, the femora dilated in middle, the tibiae basally constricted, white, becoming dilated in region of an indefinite black band, then brown and wider at apex. Hind tarsi velvety brown, metatarsi equal in length to remaining tarsal segments, not conspicuously swollen. Halteres yellowish-brown. Wings elongate, anteriorly clouded to region of spurious vein which is more of a fold than a true vein. Apex and lower margin of second basal cell clouded. Microtrichia more abundant in brown clouded area than in clear, iridescent areas.

*Abdomen:* Spatulate, basally as wide as thorax becoming strongly constricted at apex of second segment. Lateral edges of first and second segments turned under. Third segment basally constricted, light yellow at constriction, becoming strongly dilated distally, with distinct median and lateral areas of golden hairs. Fourth segment strongly convex dorsally, bulb-shaped, with distal half clothed in golden hairs. Posterior margin of fourth segment V-shaped. Fifth segment tapers apically and is cut off at apex; evenly covered with golden hairs. The abdomen, with the exception of base of third segment, is black, evenly punctate and strongly concave ventrally, sterna closely appressed to roof of the abdomen.

Length 12.5 mm.

MALE

Slightly smaller than female, abdomen beyond the constriction is considerably smaller in length and width and rounded apically. Costal cell only lightly dusted with brown. Middle femur definitely bowed and scutellar spines noticeably reduced. Posterior margin of fourth abdominal segment transverse; golden hairs in this region more abundant and in two lateral appressed patterns. Abdomen ventrally flattened but not concave. Genitalia folded inward but conspicuous.

Length 12 mm.

Types: Holotype female from Sunnyside Canyon, Huachuca Mountains, Arizona, July 9, 1940, L. J. Lipovsky. Allotype male, same locality and date, D. E. Hardy. Both types in the Snow Entomological Museum, University of Kansas.

LITERATURE CITED

Arribalzaga, F. L., 1891. Dipterologia Argentina (Syrphidae). Annales de la Sociedad cientifica Argentina. 32:195-198.

———, 1892. Dipterologia Argentina (Syrphidae). Annales de la Sociedad cientifica Argentina. 34:251-252.

Giglio-Tos, E., 1891. Diagnosi di quattro nuovi generi di Ditteri. Bollettino Universita Torino. 6(108):3.

———, 1892. Sui due generi di Sirfidi, *Rhopalosyrphus* ed *Omegasyrphus*. Bollettino Universita Torino. 7(118):1-2.

———, 1892. Ditteri Del Messico, Parte 1. Stratiomyidae-Syrphidae. Memoirs Royal Academy of Science, Torino. 43:131.

Hull, F. M., 1949. The Morphology and Inter-relationships of the Genera of Syrphid Flies, Recent and Fossil. Transactions of the Zoological Society of London. 26(4):312.

Sack, P., 1921. Syrphiden, *in* Zürcher, L., Dipteren-Ausbeute. Archiv für Naturgeschichte. 87, Abt. A, Heft 3:127-149.

Williston, S. W., 1892. Biologia Centrali-Americana. Insecta, Diptera. 3:78.

## INDEX TO VOLUME 29

*Agnocoris rubicunda* in North America (Hemiptera, Miridae) ..... 37
Allred, Dorald M., article by .....113
Anderson, Lauren D., article by ..... 41
Bibionidae (Diptera), The Walker types of ..... 85
Borland, J. C., article by ..... 29
Butterflies, Use of mirrors to display .... 41
Capelle, Kenneth J., article by .....170
*Cenocorixa*, A new, from the northwestern United States (Hemiptera, Corixidae) ..... 39
Chloropidae (Diptera), Lectotypes of African ..... 19
*Colymbetes* (Coleoptera, Dytiscidae), Evidence of intergradation between putative species of, in South Dakota 79
Device for exposing tergal and sternal structures in bees, A ..... 83
Effects of high soil and air temperature on certain alfalfa insects ..... 1
Emerson, K. C., articles by ..... 21, 63
*Errata* ..... 36
*Eurycotis floridana* (F. Walker), Variations in the ovipositor of a wingless cockroach ..... 47
*Eysenbeckia incisularis* (Say), Notes on the biology and feeding habits of, (Diptera, Tabanidae) ..... 43
Fronk, W. Don, article by .....141
Hardy, D. Elmo, article by ..... 85
Hesperiid, *Atalopedes campestris* (Bdv.) as a pest of Bermuda grass pastures, A .....139
Hungerford, H. B., article by ..... 37
Hurd, Paul D., Jr., article by .....168
Insect fauna of Cucurbit flowers .....141
Johnson, Metta McD., article by ..... 41
Jones, Calvin M., article by ..... 43
Lane, Merton C., article by ..... 43
Lawson, Fred A., article by ..... 47
Mallophaga (chewing lice) occurring on domestic chicken ..... 63
Matsuda, Ryuichi, articles by .....92, 146
Menoponidae (Mallophaga) found on North American swifts, The ..... 21
Mites of the genus *Brevisterna* Keegan, 1949 (Acarina, Haemogamasidae) ..113
Moore, Thomas E., article by ..... 37
Morphology of the thoracic exoskeleton and musculature of a mayfly *Siphlonurus columbianus* McDunnough (Siphlonuridae, Ephemeroptera). A contribution to the subcoxal theory of the insect thorax ..... 92
Moser, John C., article by ..... 57
Mosquitoes (Culicinae), Notes on the, of the Crete (Nebraska) region ..... 55
Moure, J. S., article by ..... 83
Musculature of the head of *Agulla adnixa* (Hagen), (Neuroptera, Raphidiidae) .....146
Nasal mite (Rhinonyssidae) from the horned lark, A new, and taxonomic miscellanea on several other species 133
*Neotrombidium* (Acarina, Trombidioidea) in the United States, The genus ..... 29
Pratt, Harry D., article by ..... 21
Rapp, William F., article by ..... 55
Reinhard, H. J., article by .....155
*Rhopalosyrphus*, The genus, with a description of a new species from Arizona (Diptera, Syrphidae) .....170
Roberts, J. E., article by .....139
Sabrosky, Curtis W., article by ..... 19
Severin, H. S., article by ..... 79
Slater, James E. .....141
Smith, Roger C., article by ..... 1
Spider wasps, New host records for North American, (Hymenoptera, Pompilidae) .....168
Strandtmann, R. W., articles by ....113, 133
Tachinid genus *Leucostoma* (Diptera), A synopsis of the .....155
*Torymus* (Hymenoptera, Torymidae), A new species of, parasitic on *Pachypsylla celtidis-vesicula* Riley (Chermidae) with notes on its biology and other parasitoids attacking the same host at Columbus, Ohio .... 57
Warren, L. O., article by .....139
Wasbauer, Marius S., article by .....168
Wireworm, New name for an economic 35
Young, F. N., article by ..... 79

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CONTENTS OF THIS NUMBER

A New Nasal Mite (Rhinonyssidae) From the Horned Lark, and Taxonomic Miscellanea on Several Other Species
R. W. Strandtmann ..... 133

A Hesperiid, *Atalopedes campestris* (Bdv.) as a Pest of Bermuda Grass Pastures
L. O. Warren and J. E. Roberts ..... 139

Insect Fauna of Cucurbit Flowers
W. Don Fronk and James A. Slater ..... 141

Musculature of the Head of *Agulla adnixa* (Hagen) (Neuroptera, Raphidiidae)
Ryuichi Matsuda ..... 146

A Synopsis of the Tachinid Genus *Leucostoma* (Diptera)
H. J. Reinhard ..... 155

New Host Records for North American Spider-Wasps (Hymenoptera: Pompilidae)
Paul D. Hurd, Jr. and Marius S. Wasbauer ..... 168

The Genus *Rhopalosyrphus,* With a Description of a New Species From Arizona (Diptera, Syrphidae)
Kenneth J. Capelle ..... 170

Index to Volume 29 ..... 176